ESSAYS ON THE ECONOMICS OF MIGRATION FROM DEVELOPING COUNTRIES

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A tous les "sacrifiés" de l'immigration clandestine

En espérant que votre mort ne soit jamais vaine...

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Abstract

The aim of this thesis is to study through four essays the economics of migration from developing countries. The first chapter assesses the effect of natural disasters (mainly due to climate change), in developing countries, on migration rates and looks at how this effect varies according to the level of education of people. Our results show that natural disasters are positively associated with emigration rates and also involve the migration of highly skilled people. The second chapter presents the different channels explaining the intention to migrate illegally. One of the novelties of the analysis is that it uses a tailor-made survey among urban Senegalese individuals. We find that potential illegal migrants are willing to accept a substantial risk of death and tend to be young, single and with a low level of education. We also show that the price of illegal migration, migrant networks, high expectations, tight immigration policies and the preferred destination country all play a role in the willingness to migrate illegally. The third chapter completes the second one by studying the role of risk-aversion and discount rate in illegal migration from Senegal. Our results show that these individual preferences matter in the willingness to migrate illegally and to pay a smuggler. Finally in the fourth chapter, we are interested in the effect of migrants on credit markets in a rural Senegalese context. According to our results, having a migrant in a household increases both the likelihood of having a loan and its size, whether the loan is formal or informal. We also find that this positive effect remains significant no matter if the loan is taken for professional activities or simply to buy food.

Keywords: Migration; Climate change; Natural disasters; Senegal; Illegal migration; Intentions, Risk-aversion; Discount rate; Credit markets.

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General Introduction

In this thesis, we are interested in the economics of migration from developing countries both from a macroeconomic and a microeconomic perspective. First, we investigate the relationship between natural disasters, mainly due to climate change, and migration by using panel data from developing countries. Second, we use a unique data set on potential migrants collected from urban Senegal to explain the economics of illegal migration. Third, we complete the previous study by analyzing the role of individual preferences in the willingness to migrate illegally and to pay a smuggler. Finally, we examine the relationship between migration and credit markets in the context of rural Senegal.

Environment and migration in developing countries

A sustainable development is possible only with the preservation of the environment. The first chapter of this thesis is related to the environmental issue because it raises many concerns in developing countries which have to deal with an intensification of environmental degradation partially due to climate change. This environmental decline can then induce natural disasters among other problems and may force the population of poor countries to consider migration as one of the solutions to confront this issue. According to the Stern report (2007), climate change and the resultant environmental degradation weaken states and decrease their ability to provide opportunities and services to help people become less vulnerable, above all if those people already live in marginalized areas. On top of poverty, developing countries are often in a disadvantageous situation due to rapid population growth, massive urbanization and their geographical environment, all of which make them more vulnerable and less able to adapt to environmental degradation. The latter reduces GDP growth, and increases the deficit and the external debt of countries

often already weakened economically. Furthermore, their low levels of income and their underdeveloped financial markets make for unattainable insurances and credits to cover them in case of climatic shocks. It also increases their vulnerability at the individual and national levels. There is a crowding-out effect because the poorest are obliged to reallocate their resources to deal with the consequences of environmental degradation instead of investing in human capital expenditure such as children's education or other productive investments. In the current context, less-developed countries may be then trapped in a vicious circle: their poverty makes them more vulnerable in the face of climate change and, due to their poverty, climate change will have serious consequences on health, income and growth prospects and will worsen their poverty and vulnerability.

The economic context of Senegal

Three chapters of this thesis are related to the Senegalese context. In order to justify our choice of country to study and to have a better understanding of the situation of Senegal, we present the main socio-economic indicators and the situation that has led to the intensification of international migration from Senegal since the eighties.[1]

According to ESAM II (Enquête Sénégalaise Auprès des Ménages) and the ESPS (Enquête de Suivi de la Pauvreté au Sénégal), in 2010, GDP was estimated at 6 367 billion of Fcfa i.e. 9, 697 billion Euros and GDP per capita was estimated at 509 096 Fcfa i.e. 775 Euros. The HDI (Human Development Index) was estimated at 0.464, ranking Senegal in 166th place out of 182 countries. The poverty rate remains high even though it significantly decreased between 2002 and 2005.[2] According to The share of households

[1]We are interested in indicators from 2005 to 2010 because chapters 2 and 3 about illegal migration are based on a survey conducted in 2006 and chapter 4 about the relationship between migration and credit markets uses data collected in 2009.

[2]Source: Poverty Reduction Strategic Papers (PSRP II) 2011-2015.

living beneath the poverty line was estimated at 48.5% in 2002 whereas it represented 42.6% in 2005. However, these impartial measures showing a decrease of the poverty rate are different from the perception of Senegalese households. For instance, 52% of households considered themselves as poor in 2005-2006 and 44% think that poverty has worsened during the last five years. Moreover, the growth rate was lower than 3% each year from 2006 to 2009 which represents a decrease relative to its historical trend (5% from 1994 to 2005). Young people represent 52% of the unemployed and are those who suffer the most in this economic situation.[3] The economic crisis of 2008 and low productivity in the agricultural sector may explain a large part of these figures. Growth is largely dependent on climatic events which were not favorable during these last years. The strategy of poverty reduction was then slowed down by shocks, faced by the population above all in rural areas, such as locust plagues, unseasonably heavy rains, floods and droughts. Another explanation of the economic downturn is related to issues faced by the private sector which has to deal with a lack of competitiveness due to high production costs, administrative burdens, badly functioning infrastructure such as untimely power cuts or transportation issues, above all in Dakar, and the difficulty of getting access to funding. Nevertheless, some improvements have been made particularly with APIX (Agence chargée de la Promotion, de l'Investissement et des grands travauX). The role of this national agency is to promote a good business environment in order to spark the interest of investors. Efforts have also been made to improve social indicators. Education and health sectors have an important place in the development strategy of the country. From 2005, 50% of the national budget was allocated to these sectors (40% for education

[3]Source : Poverty Reduction Strategic Papers (PSRP II) 2011-2015 and Situation Economique et Sociale du Senegal en 2010 - Agence Nationale de la Statistique du Senegal : www.ands.sn.

and 10% for health). Unfortunately these improvements have to be put into perspective with the inefficiency of the education system in terms of insertion for instance, or the poor quality of teachers.

Moreover, there are many issues related to two of the main economic sectors of Senegal, namely agriculture and fishing. According to the PSRP II 2011-2015, 60 % of the Senegalese population work and derive their income from the agricultural sector. Issues related to agriculture affect both food producers and producers of cash crops such as peanuts. Living conditions are very difficult in rural areas because of the lack of drinking water, electricity, roads and infrastructure in general; methods used are rudimentary; agricultural production is poorly diversified and the income of many farmers is dependent solely on the rain. A quick look at some facts presented in a chronological way will provide a better understanding of the issues related to the agricultural sector. Between 1960 and 1965, the agricultural sector was performing well but from the end of the seventies and the beginning of the eighties, rural areas were confronted by successive droughts. At the same time, the sector experienced a global downturn in prices which resulted in the decline of agricultural production. In the middle of the eighties, Senegal benefited from Structural Adjustments in order to solve the economic imbalances and to generate sustainable growth. However, these programs had negative effects on the rural sector because they progressively removed subsidies of fertilizers allocated to farmers who then had to borrow in order to seed. Unfortunately the bad climatic situation and the decrease of crop prices obliged them to borrow yet more in order to repay their loans. Furthermore, according to the PSRP II covering the period from 2003 to 2005, even if the currency devaluation of 1994 allowed an improvement in the price competitiveness of Senegalese exports, it was

not enough to increase foreign trade. The country exported large quantities of peanuts which are less in demand at a global level and which suffer from constraints related to access to international markets. In 2001, the government tried to support agricultural activity through the SONACOS (SOciété NAtionale de Commercialisation des Oléagineux du Senegal) which is the national firm in charge of the marketing of oilseed in Senegal. This solution was unfortunately not viable because the firm became deeply in debt in order to buy the agricultural production. The Senegalese government then liberalized the sector by giving fewer subsidies. The government also decreased the prices paid to farmers and the quantities purchased. The situation further deteriorated in 2002 because of unfavorable climatic conditions. In addition to all these elements, the insufficiency of agricultural production led to starvation in many rural areas. This agricultural situation probably helps to explain an increase, from 2005, in the pressure to migrate illegally. The Senegalese government at this time showed a political will to improve the sector. It created the REVA (REtour Vers l'Agriculture) program meaning a return to agriculture and whose purpose was to promote the insertion of young people into agriculture. However, the REVA project did not seem to be adapted to the qualification and the will of young people. The government also created the GOANA (Grande Offensive Agricole pour la Nourriture et l'Abondance) project in 2008 in order to improve production, income and food security in rural areas. This political will is valuable but it is not yet enough to cope with the structural issues of the sector.

The second main economic sector in crisis is the fisheries. Issues related to this sector are due to a dwindling of fish stocks and the disappearance of many species as a result of overexploitation. This is largely due to the competition of foreign fishing boats. For

instance, in 1979, Senegal was one of the first countries to sign an agreement with the European Union to allow it to fish within its territorial waters. In 2005 and 2006 an agreement allowed 125 ships from the European Union access to Senegalese waters. These agreements are very useful in terms of revenue but they are costly for the fishing industry (UNDP, 2005; OCDE, 2006).[4] Moreover, increases in the price of oil made this activity very expensive.

Many people from rural and urban areas therefore have to deal with bad living conditions because of the economic situation described above. This makes them more vulnerable to, and less able to cope with, negative shocks which can result in a vicious circle of poverty. It also explains their desire to leave rural areas and even the country because rural-urban migration is no longer enough to improve their quality of life. Therefore, international migration has become for them one of the survival strategies.

Senegal is both a country of immigration and emigration. However, since the eighties, emigration exceeds immigration. According to the definition of the Ministry of Senegalese living abroad, the number of Senegalese living abroad is estimated at 3 000 000 and this figure is underestimated because it does not take into account either people who do not register at the Senegalese Consular service in the host country or illegal immigrants.[5] [6] Between 1999 and 2004, 46% of Senegalese migrants went to Europe, 44% to Africa and

[4]In Dayton-Johnson et al. (2006).

[5]There are three different sources of data about emigrants from Senegal. According to the RGPH (Recensement Général de la Population et de l'Habitat) 2002, the Senegalese census, an emigrant is an individual who left Senegal at least five years before the census and who was absent at the time of the census. This definition is different from the one of the Ministry of Senegalese living abroad. Their conception is larger because it includes all people with Senegalese citizenship living abroad either for a long time, recently or who were born in a foreign country.

[6]Source : Situation Economique et Sociale du Senegal (2010)- Agence Nationale de la Statistique du Senegal : www.ands.sn .

8% to the U.S..[7] The first international destination was France, followed by Italy, the U.S. and Spain. However, the French destination is largely becoming replaced by the three other countries (Fall, 2010). Employment is the main reason for migration, followed by education and family purposes. The Senegalese migrant tends to be young, male and relatively well educated. The rate of return migration is estimated at 9% which is quite low. Senegal is one of the main recipient African countries of remittances which represent 9.3% of the GDP (Ratha et al., 2011). Migrants consequently have an important economic power and contribute much to the improvement of living conditions of their families left behind.

Outline of the thesis

The thesis presents four chapters that relate the migration issue to three major challenges faced by developing countries namely the environmental issue, the phenomenon of illegal migration and the development of the credit markets.

The first chapter assesses, in developing countries, the effect of natural disasters mainly due to climate change on migration rates and looks at how this effect varies according to the level of education. The relationship between climate change, natural disasters and migration is crucial because developed countries need to manage the complicated issues of additional incoming migratory flows caused by environmental degradation. We investigate this relationship by using panel data from developing countries. Estimations are made with a country fixed effects estimator. The results show that natural disasters are positively associated with emigration rates. Another contribution of the study is to show that natural disasters mainly due to climate change exacerbate the brain drain in

[7]Direction de la Prévision et de la Statistique (2004).

developing countries when those are at their most vulnerable and need greater support from skilled workers. We also find that this effect is not homogeneous and depends on geographical location of countries.

The second chapter presents the different channels explaining the willingness to migrate illegally. One of the novelties of the analysis is that it uses a tailor-made survey among urban Senegalese individuals. We show that potential illegal migrants are willing to accept a substantial risk of death (25% at the median) and tend to be young, single and with a low level of education. We also find that the price of illegal migration, migrant networks and high expectations towards the living standards in the popular destination countries, all play an important role in the consideration of an individual to decide to migrate illegally. Furthermore, potential illegal migrants may not be deterred by a tightening of immigration policies. A detailed analysis shows that some particular destinations are more attractive in the willingness to migrate illegally.

The third chapter completes the second one by studying the role of time and risk preferences in illegal migration from Senegal. On the basis of our theoretical model, we evaluate a measure of the time and risk preferences through individual discount rates and individual coefficients of absolute risk aversion. Then, we empirically test our theoretical propositions and we show that in addition to other determinants of migration such as the expected foreign wage, networks, immigration policies or migration prices, individual preferences matter in the willingness to migrate illegally and to pay a smuggler.

Finally in the last chapter, we look at how migrants affect rural credit markets in a Senegalese context. We assume that migrants can influence the credit markets by being the collateral and the "element of trust" in the credit contract between the borrower and

the lender because they represent a potential solution and can play an insurance role in case of non-repayment. Therefore, we are interested in the effect of having a migrant in a household on the likelihood of having a loan and on the size of the loan. After controlling for potential reverse causation of the migration variable, results show that having a migrant in a household increases both the likelihood of having a loan and the loan size, whether the loan is formal or informal. However, the effect is stronger for the informal than for the formal loan size. We also find that this positive effect remains significant no matter if the loan is taken for professional activities or simply to buy food.

Chapter 1

Climate Change, Natural Disasters and Migration: An Empirical Analysis in Developing Countries

1.1. Introduction

International migration is a great concern to developing countries. The movement of human capital is led by economic, demographic, political, social, cultural and environmental factors in both the sending countries (push factors) as well as in destination countries (pull factors). The main reason for international migration found in the theoretical and

[0]The chapter is joint work with Alassane Drabo (CERDI, Université d'Auvergne).

[0]Earlier versions of this chapter were presented at the 17th Annual International Sustainable Development Research Conference at the Earth Institute, Columbia University in New York and at the IZA workshop on Environment and Labor in Bonn. We are very grateful to conference and workshop participants for their helpful comments and suggestions. We also thank Simone Bertoli for useful discussions. The usual disclaimer applies.

the empirical literature is differences in economic opportunities or, more precisely, wages differential (Harris and Todaro, 1970; Ghatak, Levine and Price, 1996). Beyond the wages differential, migration is considered as a way to diversify income sources (Stark, 1991), to deal with bad political institutions, large social disparities, conflicts, and the lack of good infrastructure. People also migrate for family reunification or to join relatives abroad. Finally, because of globalization, there is a decreasing of the uncertainty, caused by modern communication technologies such as the internet and satellite TV, which might be an explanation for persistently rising migration in recent decades. In a word, migration is a possibility for people to improve their quality of life and all the factors previously named can be directly or indirectly affected by climate change and natural disasters.

History demonstrates that climate change is often associated with massive movements of population and that the natural environment is probably the oldest determinant of migration and population displacement. Many studies such as the Stern report (2007) and the Intergovernmental Panel on Climate Change (IPCC, 2007) predict an intensification of climate change for the forthcoming years. According to the International Organization for Migration (IOM), by the half century, 200 million people (equal to the current estimate of international migrants) could be permanent or temporary environmental migrants[1] within their countries or overseas. Climate change has, thus, taken an important place in world governance. But the partial failure of important meetings on climate change issue (Copenhagen Conference 2009, Rio 2011, Durban 2011) shows that it is difficult for

[1]We consider the term "environmental migrants", because it is larger and inclusive than environmental refugees. It takes into account the forced population displacement due to environmental reasons; with push factors largely more determinant then pull factors (see Appendix A.1 for other definitions).

the states to agree on the strategy to adopt in order to reduce their impact on the environment. The interests and the means of action are different according to each nation's level of development. Indeed, developed countries are responsible for an important part[2] of pollution and greenhouse gas emission compared to developing countries, which bear the brunt of this environmental degradation and are disproportionately affected because of their economic vulnerability and their lack of means due to poverty. This environmental decline can induce natural disasters among other problems and, for the population of those countries, migration is one of the solutions to confront this issue. The management of supplementary migratory flows due to environmental degradation are made more complicated for developed countries by issues of migration from developing countries. Environmental migration is often at the origin of population displacement which can affect the stability of the hosting areas in many ways. It can induce conflicts with local populations by putting pressure on employment and local wages, trade and natural resources such as water, especially if those regions are already poor.

Since the second half of the eighties, many studies have been conducted on the effect of climate change on involuntary population displacement. In recent decades, Reuveny (2007) argues that the effects of climate change on migration can be predicted by exploring the effects of environmental problems on migration. People can adapt to these problems by either staying in place and doing nothing, staying in place and mitigating the problems, or by leaving the affected areas, depending on the extent of problems and the mitigation capabilities. According to Smith (2007) migration on a permanent or temporary basis has always been one of the most important survival strategies adopted by people confronted by

[2]Rich countries will be responsible for 60-80% of gas emission by 2050 (Stern, 2007).

natural or human-caused disasters. Naudé (2010) shows in the Sub-Saharan Africa context that environmental pressure has an impact on migration through the frequency of natural disasters. Poston et al., (2009) show the effect of climate change on in-migration, out-migration and net migration among 50 states of the United States of America and their results are confirmed by Reuveny and Moore (2009) who demonstrate that environmental decline plays a statistically significant role in out-migration, pushing people to leave their homes and move to other countries. Finally, Marchiori and Schumacher (2011) found that minor impacts of climate change have major impacts on the numbers of migrants.

Relative to this literature, the main contribution and the aim of this chapter is to examine the relationship between climate change and migration by studying the effect on migration rates of natural disasters caused by climate change but above all, and different from previous studies, by examining the effect of natural disasters on migration in the context of the level of people's education.

The chapter then investigates the relationship between climate change, migration and natural disasters by using panel data from developing countries. Estimations are made with a country fixed effects estimator through an accurate econometric model and the results confirm previous studies, namely that natural disasters are positively associated with emigration rates. But, beyond this, the chapter shows that natural disasters mainly due to climate change exacerbate the brain drain in developing countries by involving the migration of highly skilled people, and this effect varies depending on the geographical location of the countries.

The next section presents a literature review on the climate change issue in developing countries and the relationship between climate change, natural disasters and migration.

In Section 1.3 we present the empirical design while the estimations results and robustness checks are discussed in Section 1.4. Concluding remarks and implications are provided in the last section.

1.2. Literature review

The forecasts concerning environmental issues due to climate change are alarming. According to Dyson (2006), there will inevitably be a major rise in atmospheric CO2 during the 21st century due among other causes to the momentum in economic and demographic processes. Stern (2007) warns that, by 2035, a rise in temperature of over 2°C induced by a rapid increase of greenhouse gas emissions could be doubled compared with its pre-industrial level.[3] In the long term, the temperature rise may exceed 5°C, which is equivalent to the change in average temperatures from the last ice age to today. Marine eco-systems and food stocks are threatened by oceanic acidification due to carbon dioxide levels. Due to global warming, the Arctic will be ice-free in summer by 2100 because of a reduction of sea ice, and 15 to 40% of its species may become extinct. Melting glaciers will result in a rise in sea levels, particularly in the subtropics (Meehl and al., 2006), putting pressure on coastal areas and small islands. It will also threaten 4 million km^2 of land representing home to 5% of the world's population, and may increase flood risks during wet seasons and reduced water supplies to one sixth of the world's population. Global warming, by altering the environment, has a significant effect on human health and infectious diseases (Schrag and Wiener, 1995; Khasnis and Nettleman, 2005). It

[3]According to this report, average global temperatures could increase by 2-3°C within the next fifty years.

entails natural disasters which affect housing, infrastructure, crop yield and livestock and consequently weakens economies (Perch-Nielsen et al., 2008).

1.2.1. Climate change issue in developing countries

Climate has a significant effect on well-being and levels of happiness. Rehdanz and Maddison (2005) show that temperature changes benefit high latitude countries whereas they negatively affect low latitude countries. Indeed, a small amount of global warming would increase the happiness of those living in Northern countries, whereas it is the reverse for people living in high temperature regions. According to Stern (2007), predictions for developing countries reveal alarming future agricultural output and a reduction in crop yields, food security and issues related to water. Climate change involves droughts which are responsible for an increase in food prices, disease, and consequently an increase in health expenditure. Moreover, populations have to deal with the issue of water, the most climate sensitive economic resource for these countries. In South Asia, for example, climate change will increase rainfall and flooding with a direct effect on agricultural production, and with serious consequences in a region with a high population growth. In Latin America and Caribbean areas, serious threats exist to the rainforests with direct consequences for the subsistence of populations depending on the Amazonian forest. In Sub-Saharan Africa, an increase in sea level threatens coastal cities when higher temperatures raise risks of malnutrition, starvation and malaria, decreased river flow and the subsequent availability of water. In the Nile Basin, the Middle East and North African countries, water stress and severe droughts could cause migration and violent conflicts.[4]

[4]In SSA, on 80 million people suffering of starvation due to environmental factors, 7 million migrated to obtain food (Myers, 2005). The increasing in temperature of 2°C involve an increasing in population

Many developing countries are experiencing an increase in the frequency and costs of natural disasters which are estimated on average at 5% of their GDP between 1997 and 2001 (IMF, 2003). In India and South East Asia the reduction in GDP due to climate change is estimated between 9 and 13% by 2100 compared with a situation without climate change. The cost of adaptation for these countries will be at least between 5% and 10% of GDP and will weigh on government budgets, all the more so since less than 1% of losses from natural disasters were insured in low-income countries from 1985 to 1999. The frequency of climate events does not give time to rebuild or reconstitute their patrimony, keeping them in a poverty trap. Immediate and strong reactions are then necessary for these specific countries to limit the serious impact of climate change on them. In spite of this situation described previously, climate change is unfortunately considered as a long-term problem and future impacts of climate change do not have priority. Concerning this point, Ikeme (2003) analyzes the low capacity adaptation of Sub-Saharan Africa (SSA) countries to cope with climate change effects. Low adaptive capacity increases vulnerability, social and economic costs which affect human capital and the development levels of these areas, which constitute transmission channels for migration. For these countries, adaptation does not appear to be urgent issue and is underestimated by these most vulnerable countries. Indeed, even if adaptation is globally recognized as a means to preventing and coping with the impacts of climate change, there is a relative indifference and insufficient measures in order to reinforce the capacity of adaptation. These countries are often in a difficult context with problems such as poverty, institutional weakness, low

affected by malaria in Africa of 40-80 million people (70-80 million people affected with an increasing of 3°C-4°C). By 2020, between 75 and 250 million of African people will be exposed to water stress caused by climate change (Stern, 2007).

levels of education and skills or an inexistence of welfare systems; they are then obliged to act in emergency in case of climate effects (Washington and al., 2006). Moreover, developing countries, particularly in SSA, consider the developed countries to be the major cause of climate change, and wish to let them take the responsibility to manage them.

1.2.2. How climate change and natural disasters can affect migration?

Migration is considered as a possible adaptive response to risks associated with climate change (Mcleman and Smit, 2006). Using Northern Ethiopia as an example, Meze-Hausken (2000) shows how climate change triggers migration in dryland areas of less developed countries. The impact of drought on migration depends on the intensity of the change, the vulnerability of the individual who suffers the change and the availability of survival strategies. The intensity of the climate change includes damage caused by the combination of natural, socio-economic, technological and perceived conditions. The vulnerability means an individual's risk of exposure to the severe consequences of climatic disaster and the incapacity to cope with its consequences. Survival strategies are actions taken to avert and to manage the climatic disaster after the event. At the beginning of a drought, not all people are equally vulnerable in the face of the climatic change. Families with more survival strategies manage to resist migration longer than those with fewer survival strategies. But there comes a time after which survival strategies are reduced for all members of society at which point all people are affected in similar ways and are obliged to migrate. Migration is a solution to the failure of different survival strategies.

Nevertheless it is important to recognize that, in regions already with a high level of poverty and difficult living conditions, climatic change is a triggering factor of migration.

Notwithstanding this, views differ on whether migration could be considered as adaptation. Some characterize migration as a failure of, rather than as a form of, adaptation. Some operational organizations and academics point out the role that migration may play in helping home communities to adapt themselves, using the resources from migrant remittances (IOM, 2007; Barnett and Jones, 2002). Others express the view that migration is a maladaptive response because the migration may trigger an increased risk for those who move and also possibly for areas towards which migrants move (Oliver-Smith, 2009). Socially some factors including governance help determine whether people, threatened by rapid or slow onset environmental change, can remain in their homes or return once the threat has passed. For instance, in the aftermath of Hurricane Katrina, out of the 1.5 million people displaced, only one-third returned and governance played a large role in that instance, underlining the need to understand how social and ecological factors interact and shape human mobility in the face of global environmental change (Warner, 2010).

According to Naudé (2010), climate change affects and can intensify migration through three channels, namely scarcity of water and land, natural hazards, and conflicts over natural resources. Indeed, migration towards new areas is often one of the main factors of environmental conflicts (Baechler, 1999b; Swain, 1993; Swain, 1996). Climate change may cause tensions and conflicts in communities receiving migrants (Barnett and Adger, 2007). McGregor (1994), studying the link between environmental change, migration and food security, shows that the displacement of a population due to climate change can

induce conflicts linked to the food security of the hosting areas. Food aid given to the refugees may destabilize food prices and the local production of the host economy, which in turn can cause malnutrition in refugee camps or weaken some regions already affected by food shortages.

1.2.3. Some stylized facts

Many stylized facts illustrate the relationship between climate change, natural disasters and migration. In Chinese ancient history, between 3550 and 2200 BC, during China's Bronze Age, the settled Zhou tribes experienced conflicts with the nomadic Rong and Di tribes and were relocated five times. Historians attributed these migrations only to political and military reasons whereas the movement of populations was also caused by climate change. Those migrations were a means to protect agriculture by conserving resources in order to economize food production threatened by drought (Huang and Su, 2008). The climatic factor also influenced Polynesian migrations between 300 and 1400 (Bridgman, 1983).

Similarly in Asia in 1975, as a method of increasing self-reliance and to provide food security to its population, India constructed the Farraka dam on the River Ganges permitting large-scale irrigation of state land. But this project, by over-exploiting the river and diverting most of the Ganges' dry-season water, and without consulting Bangladesh which shares the river, induced serious ecological and political consequences. The consequential environmental degradation affected the living conditions of Bangladeshis through

the destabilization of their ecosystem, the destruction of their essential sources of livelihood such as agriculture, industrial production and fishing. The environmental destruction caused by the Indian dam firstly affected the rural ecosystem and then displaced the Bangladesh population towards urban areas. But the low absorption capacity of Bangladesh cities made migration to India the only viable alternative. Subsequently the environmentally-caused displacement of the Bangladeshi migrants constituted a burden for Indian society, putting pressure on the availability of food and the labor market. Since these migrants were Muslims yet the major proportion of the receiving country was Hindu, problems were intensified by ethnic and political issues. Tensions between migrants and natives of the host country resulted in regional conflict which then spread to other parts of India (Swain, 1996). In Mali in the 1970s and 1980s, drought caused the migration of Tuareg people towards other countries. When they returned to Mali they were marginalized by the competition between nomad and settled people, resulting in a rebellion in 1990 (Meier and Bond, 2007). The El Niño events between the 1970s and 1990s caused extended droughts in Ethiopia. They were followed by famine and political turmoil that resulted in radical changes of government, secession, and a massive program of population redistribution. The consequences of government-imposed migration policies, whose catalyst was climate change caused by repeated El Niño events, were certain changes in the ethnic composition and the geographic pattern of population growth of certain Ethiopian regions (Comenetz and Caviedes, 2002). Repeated droughts in the Senegal River basin triggered a conflict between Senegal and Mauritania which started when the river began to recede (Niasse, 2005). In 1996-1997 a severe drought induced a mass migration from Kenya to Somalia and Ethiopia. Because of a lack of adaptation and efficient measures,

countries such as Madagascar, Zimbabwe and Kenya viewed their economies seriously affected respectively by droughts in 1992, floods in 1998, and cyclones in 2000. Nigeria, Senegal and Angola are all vulnerable to rises in sea level and flooding which affected thousands of people (Ikeme, 2003; Benson and Clay, 1998; Ngecu and Mathu, 1999). In 2004, the tsunami in Indonesia displaced 500,000 people whereas Hurricane Katrina in 2005 had serious consequences on human displacement with tens of thousands of migrants in 26 states of the USA. Hurricane Mitch, like Katrina, had a devastating effect on the most vulnerable people and increased male migration from Honduras to Nicaragua (Smith, 2007).

1.3. Empirical design

The empirical framework is developed in this section and, before presenting the data, the main specifications showing the different relationships between natural disasters and migration are discussed.

1.3.1. Methodology

Firstly, the effect of natural disasters caused by climate change on net migration rates is estimated using the following specification:

$$mig_{i,t} = \alpha_1 disaster_{i,t} + \alpha_k X_{k,i,t} + \mu_i + \epsilon_{i,t} \tag{1.1}$$

Where $mig_{i,t}$ and $disaster_{i,t}$ are respectively the migration and natural disaster variables for the country i at the period t; $X_{k,i,t}$ is the vector of control variables generally

used in migration estimations; μ_i represents the countries fixed effects and $\epsilon_{i,t}$ the error term. The coefficient of natural disasters is expected to be positive.

Secondly, the analysis is specified by taking migration rates according to the education levels. We are interested in this point because we assume that natural disasters caused by climate change may affect the migration of people who are more educated or those who are more skilled. Often they are those who get a job and a salary so they have the means to go abroad, to be safe, and to provide insurance for their family back in the affected country. With respect to policy implications, they can induce a brain drain whose effects will be more serious in this context where countries need large support for rebuilding and have a special need for skilled workers. We assume that this effect is higher for the most highly educated. Thus we have:

$$migeduc^{j}_{i,t} = \alpha^{j}_{1} disaster_{i,t} + \alpha^{j}_{k} X_{k,i,t} + \mu_i + \epsilon^{j}_{i,t} \tag{1.2}$$

Where $migeduc^{j}_{i,t}$ is the migration rate associated with each educational level j (j= low, medium and high educational levels).

The two objectives already discussed are estimated by using country OLS fixed effects estimator through an accurate econometric model. However, one may assume some endogeneity issues caused by measurement errors of the variable of interest or by a potential double causation bias between migration and natural disasters. But in our case we do not have these problems because we eliminate the measurement errors by using the Center for Research on the Epidemiology of Disasters (CRED) data which identifies the number

of natural disasters each time such events arrive. Secondly, we assume that migration at the period t cannot cause natural disasters at t or before t, but only in the future. Since we estimate the effect of the number of natural disasters at the period t on the migration rate at the same period, we do not have a double causality issue.

1.3.2. Data

The objective of this chapter is to assess the effect of natural disasters caused by climate change on global migration rates and on migration rates according to the level of education. This relationship is investigated by using panel data with countries as unit observations. The dependent variables are the net migration rates between 1950 and 2010 made available by the United Nations Population Division and measured as the number of immigrants minus the number of emigrants over the period, divided by the person-years lived by the population of the receiving country over that period. It is expressed as the net number of migrants per 1,000 population. However, we choose to use the opposite of this measure (the difference between the total number of emigrants minus the number of immigrants divided by the person-years lived by the population of the receiving country over that period) to be in conformity with the other migration indicators with regard to their sign: indeed, a higher level of these variables indicates a higher level of migration.

We also use the Panel Data on International Migration of M. Schiff and M.C Sjöblom (2008) (World Bank Databases)[5], which measures international migration from 1975 to 2000 of the six main destination countries: Australia, Canada, France, Germany, UK and USA. This data set uses the same methodology as Defoort (2008). It measures emigration

[5]http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/0,,contentMDK:21866422~pagePK:64214825~piPK:64214943~theSitePK:469382,00.html

rates through the stocks of migrants from sending countries to these countries for three educational levels, namely low, medium and high, divided by the stock of adults (+25) corresponding to the same educational level, in the country of origin plus the stock of migrants of sending countries. In order to make comparable figures with net migration variable, we multiply this rate by 1000 and thus consider the migration rate for each 1000 inhabitants. We prefer this database to that produced by Docquier and Marfouk (2006); the latter uses the same measure but for all OECD countries in 1990 and 2000, whereas the former has a larger temporal dimension and thus more observations.

For the climate change indicators representing the variables of interest, we use the Centre for Research on the Epidemiology of Disaster (CRED) data (2010) from 1900 to 2010. Firstly we use the total number of natural disasters in a country in a five year period. Secondly we are interested in: meteorological disasters using a variable which considers the number of events caused by storms; hydrological disasters using a variable which groups together the number of events caused by floods and other wet mass movements; and climatological disasters which measures the number of disasters caused by drought, wildfire and extremely high temperatures. We are interested in these three measures because they are the natural disasters which are mainly caused by climate change. All the climate change variables are divided by the logarithmic of surface area. Indeed, we assume that to compare the effect of the number and the intensity of natural disasters of a large country to a smaller one, it is more relevant to consider the climate change variables by kilometers squared to take into account the size of the country. For instance, one natural disaster in Russia or China does not have the same consequences on the whole country characteristics as compared to a smaller country.

We control for the additional explanatory variables that can influence migration (see Appendix A.2 and A.3 for the definition of variables and sources, and summary statistics). GDP per capita measures the development level of the countries. It also allows measuring their economic conjuncture. In fact, this variable provides information about some economic indicators such as the unemployment rate or the fiscal deficit. And given that panel data are used in this study, the changes over time period capture variation in the GDP per capita and then give an idea about the evolution of the economic performance. Demographic pressure is measured through variables such as the total population which is another indicator of the size of the country; the young population and the population density to control for the dynamism of the population in terms of migration. The variable availability of arable land captures the economic opportunities of a country above all in developing countries where agriculture is the main activity. The quality of the institutional situation in the country is measured through political rights and civil war variables which highly lead to displacement of population.

1.4. Results

1.4.1. Natural disasters and net migration rates

[Table 1.1 HERE]

[Table 1.2 HERE]

Estimations are made for poor and middle-to-lower income countries. Table 1.1 shows the results of the effect of natural disasters on net migration rates. Natural disasters are captured by four indicators divided by the logarithmic of surface area: the total number

of natural disasters (Column 1) and its desegregated components per km^2, namely meteorological, hydrological and climatological disasters (Column 2 to 4). The number of natural disasters per km^2 has a significant positive impact on net migration rates confirming previously documented results (Naudé, 2010; Reuveny and Moore, 2009). This result is confirmed by the sub-components of natural disasters except for the climatological variable which becomes significant with one period lag (Column 5). Moreover, if we introduce natural disasters and their disaggregated variables with one period lag (Table 1.2), it appears that all these variables are significant and positive. In a word, natural disasters have a contemporaneous and lagged effect except for climatological events that have only a lagged effect. This is due to the fact that for storms, included in meteorological disasters, or floods and wet mass movements included in hydrological events, the mitigation and adaptation capabilities are less available for these types of events than for extreme temperatures events or droughts which are in the climatological category. Indeed, during short term hydrological events, people have less choice to stay, whereas climatological events permit them time to prepare their migration in the future.

1.4.2. The effect of the intensity of natural disasters on migration

[Table 1.3 HERE]

Even though the occurrence of natural disasters is a good measure, one could assume that the intensity is more relevant in assessing the relationship between climate change and migration. Thus, to check the robustness of the previous results, we make our estimations by using, for each sub-group of natural disasters (meteorological, hydrological and climatological variables), the costs representing total damages in US$; the number

of deaths and the number of people injured, made homeless and otherwise affected. Estimations in Table 1.3 confirm the previous results in Table 1.1 except for the number of deaths and the number of people affected by hydrological disasters which are not significant. The contemporaneous effect of the intensity variables of natural disasters on net migration exists for meteorological events, but only the damage caused by hydrological events increase net migration rates.

1.4.3. The effect of natural disasters on migration according to the education level

[Table 1.4 HERE]

The effect of natural disasters on migration according to the educational level is presented in Table 1.4. The dependent variables are emigration rates with respectively low, medium and high educational levels. The interest variable remains the number of natural disasters. Only those individuals with a high level of education migrate in the case of an increased incidence in the number of natural disasters. This result can be explained by the cost of migration. In fact, skilled people are less likely to be unemployed and then can easily support migration costs. Moreover because of their skills, they can more easily get legitimate documents to enter host countries. Then, natural disasters due to climate change may heighten the brain drain phenomenon in developing countries just when they need the most skilled and qualified people to deal with the damage caused by natural disasters.

1.4.4. Robustness check: the effect of natural disasters on highly educated migrants according to geographical location

[Table 1.5 HERE]

Even if natural disasters affect all countries, it is interesting to test if the behavior of highly educated people in the face of migration depends on the geographical location of the countries. The dependent variable is the migration of highly educated populations and the variables of interest are the number of natural disasters and some interaction terms between the number of natural disasters and geographical dummies[6] . We find in Table 1.5 some differences in migration behavior in Europe and Central Asia (ECA), Latin America and Caribbean (LAC), Middle East and North Africa (MENA) and South Asia (SA) regions. The effect is positive for ECA, LAC and SA regions, where we observe increased migration rates of highly skilled people caused by natural disasters compared to other regions. For South Asia, the reason for this result may be due to the high frequency of natural disasters in this area and the low resilience of these countries. For ECA and LAC regions, we can assume that the migration policies could be more tolerant for skilled workers in general and migrants are integrated more easily in the job market of the receiving countries if they are qualified. This seems true particularly in case of negative shocks such as natural disasters. There is a negative relationship between the variable MENA and the migration variable which means that natural disasters involve less migration of highly educated people than other region. Therefore it is very unlikely that highly skilled people from the MENA region compared to the other regions migrate

[6]We do not run the estimations for each sub-region dummy because of their low sample size.

because of natural disasters.[7] We do not find any significant effect for Sub-Saharan Africa (SSA) and East Asia and Pacific (EAP) regions.

1.5. Concluding remarks and Implications

Climate change is one of the main challenges of the twenty-first century for all countries in the world in general, and in particular for developing countries which are more sensitive to its effects. This chapter assesses the relationship between natural disasters mainly caused by climate change and migration by examining migration rates and levels of education. Results, from a fixed effects estimator, show that natural disasters have a significant and positive effect on net migration rates. But this effect is different according to the disaster type. Climatological disasters have only a positive lagged effect of one period on migration, unlike the other types of disaster which have a contemporaneous and lagged positive impact on migration. We also find that the effect is not the same for the different educational levels. Natural disasters have an effect only on the migration of people with a high level of education. Finally, we find some differences in migration behavior between highly educated people in European Central Asia, Latin America and Caribbean, Middle, East and North Africa and South Asia regions.

Natural disasters mainly due to climate change raise equity issues for developing countries by heightening the brain drain effect and by taking away qualifications and skills just when these countries are at their most vulnerable. Developing countries have, of course, to make some efforts, but developed countries must provide more support and increase their political will to combat climate change and its damaging consequences above all in the

[7] All estimates presented in this study are made without dividing by the surface area and all results remain unchanged except for the size of the coefficient.

Table 1.1. Fixed effects estimation of the effect of natural disasters on international migration

	Dependent Variable: Net Migration				
Indep. Var.	(1)	(2)	(3)	(4)	(5)
Number of Natural Disasters/km^2	1.312***				
	(2.80)				
Number of Meteo Disasters/km^2		4.563**			
		(2.50)			
Number of Hydro Disasters/km^2			4.306***		
			(2.93)		
Number of Climate Disasters/km^2				-2.818	
				(0.37)	
Number of Climate Disasters lag/km^2					18.874**
					(2.17)
Log GDP per capita	-5.458*	-5.531*	-5.853*	-4.681	-5.233
	(1.69)	(1.71)	(1.80)	(1.37)	(1.66)
Log population	-35.029**	-36.289**	-26.494*	-43.431***	-41.645**
	(2.26)	(2.13)	(1.82)	(2.76)	(2.57)
Young population	-0.169	-0.162	-0.157	-0.263	-0.147
	(0.60)	(0.60)	(0.57)	(0.97)	(0.55)
Log Population Density	32.627**	34.570**	23.906*	42.093***	39.358***
	(2.34)	(2.22)	(1.83)	(2.88)	(2.72)
Percentage Arable area	-0.503	-0.494	-0.492	-0.51	-0.389
	(0.89)	(0.87)	(0.88)	(0.87)	(0.69)
Political rights	0.038	0.037	0.043	0.02	0.05
	(0.10)	(0.09)	(0.11)	(0.05)	(0.13)
Civil war	0.838**	0.929**	0.788**	0.907**	0.853**
	(2.24)	(2.43)	(2.11)	(2.37)	(2.30)
Constant	480.949**	493.778**	380.163*	578.896***	556.389**
	(2.24)	(2.16)	(1.90)	(2.67)	(2.51)
Observations	435	435	435	435	435
Countries	88	88	88	88	88
R^2	0.063	0.068	0.068	0.059	0.079

Note: Robust t statistics in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

poorest countries, for it is the latter, rather than more affluent countries, which contribute the least towards climate change and yet which suffer the greatest consequences.

Table 1.2. Fixed effects estimation of the effect of lagged natural disasters on international migration

	Dependent Variable: Net Migration			
Indep. Var.	(1)	(2)	(3)	(4)
Number of Natural Disasters lag/km^2	1.628**			
	(2.04)			
Number of Meteo Disasters lag/km^2		2.363**		
		(2.04)		
Number of Hydro Disasters lag/km^2			3.458*	
			(1.75)	
Number of Climate Disasters lag/km^2				18.874**
				(2.17)
Log GDP per capita	-5.573	-5.197	-5.437	-5.233
	(1.66)	(1.58)	(1.62)	(1.66)
Log Population	-39.117**	-41.130**	-35.925**	-41.645**
	(2.55)	(2.55)	(2.32)	(2.57)
Young population	-0.162	-0.206	-0.158	-0.147
	(0.60)	(0.73)	(0.56)	(0.55)
Log population density	36.891***	39.531***	33.959**	39.358***
	(2.72)	(2.73)	(2.46)	(2.72)
Percentage arable area	-0.478	-0.488	-0.496	-0.389
	(0.85)	(0.86)	(0.88)	(0.69)
Political rights	0.027	0.03	0.018	0.05
	(0.07)	(0.08)	(0.05)	(0.13)
Civil war	0.853**	0.892**	0.842**	0.853**
	(2.28)	(2.34)	(2.23)	(2.30)
Constant	529.924**	552.033**	489.854**	556.389**
	(2.49)	(2.48)	(2.30)	(2.51)
Observations	435	435	435	435
Countries	88	88	88	88
R^2	0.064	0.06	0.064	0.079

Note: Robust t statistics in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 1.3. Fixed effects estimation of the effect of natural disasters on international migration (other measures)

	Dependent Variable: Net migration								
Indep. Var.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log Meteo cost/km^2	2.230***								
	(2.91)								
Log Meteo death/km^2		5.928**							
		(2.24)							
Log Meteo total affected/km^2			4.437***						
			(2.78)						
Log hydrological cost/km^2				2.318**					
				(2.18)					
Log hydrological death/km^2					4.322				
					(1.38)				
Log hydrological total affected/km^2						0.038			
						(0.03)			
Log Climatological cost/km^2							0.263		
							(0.16)		
Log Climatological death/km^2								0.71	
								(0.26)	
Log Climatological total affected/km^2									-0.648
									(0.63)
Observations	435	435	435	435	435	435	435	435	435
Countries	88	88	88	88	88	88	88	88	88
R^2	0.065	0.067	0.089	0.065	0.063	0.058	0.058	0.058	0.06

Notes: Robust t statistics in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All regressions include a constant and control for the variables: log of GDP per capita, log of the population, young population, log of population density, percentage of arable area, political rights and civil war.

Table 1.4. Fixed effects estimation of the effect of natural disasters on international migration according to educational level

	Low education	Medium education	High education
Indep. Var.	(1)	(2)	(3)
Number of Natural Disasters/km^2	-0.744	2.082	17.839**
	(0.65)	(0.66)	(2.34)
Log GDP per capita	-5.247*	-15.500*	-73.368***
	(1.82)	(1.71)	(3.24)
Log population	-4.412	-178.97	-458.594***
	(0.17)	(1.26)	(3.79)
Young population	-1.318	-2.645	-0.556
	(1.53)	(1.33)	(0.26)
Log population density	2.775	173.998	430.542***
	(0.11)	(1.27)	(3.93)
Percentage arable area	0.522	1.383	5.909*
	(0.87)	(0.65)	(1.74)
Political rights	-0.886	-0.168	3.674
	(1.62)	(0.14)	(0.89)
Civil war	-0.003	0.447	4.969
	(0.01)	(0.26)	(1.13)
Constant	158.519	2417.43	6190.800***
	(0.46)	(1.36)	(3.93)
Observations	435	435	435
Countries	88	88	88
R^2	0.083	0.049	0.094

Note:Robust t statistics in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 1.5. Fixed effects estimation of the effect of natural disasters on international migration according to geographical regions

	Dependent variable: High educated migration rate					
Indep.var.	(1)	(2)	(3)	(4)	(5)	(6)
Number of Natural Disasters/km^2	22.051***	24.234	17.565**	15.965**	19.225**	11.763
	(3.31)	(1.61)	(2.29)	(2.06)	(2.52)	(1.58)
(Disaster)x(SSA)	-2.17					
	(1.17)					
(Disaster)x(EAP)		-0.735				
		(0.67)				
(Disaster)x(ECA)			7.833*			
			(1.77)			
(Disaster)x(LAC)				3.774**		
				(2.35)		
(Disaster)x(MENA)					-3.267**	
					(2.57)	
(Disaster)x(SA)						2.228*
						(1.68)
Observations	435	435	435	435	435	435
Countries	88	88	88	88	88	88
R^2	0.099	0.095	0.095	0.099	0.098	0.101

Note: Robust t statistics in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All regressions include a constant and control for the variables: log of GDP per capita, log of the population, young population, log of population density, percentage of arable area, political rights and civil war

Appendix

A.1 Definitions

A.2 Definition of variables and sources

A.3 Summary statistics

A.4 Country list

A.1 Definitions

Intergovernmental Panel on Climate Change (IPCC, 2007) definition

"Climate change in IPCC usage refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods".

Definitions of environmental migrants/ refugees

El Hinnawi (1985): Environmental migrants are "people who have been forced to leave their traditional habitat, temporarily or permanently, because of a marked environmental disruption that jeopardized their existence or seriously affected the quality of their life".

Bates (2002) criticizes the definition and classification of environmental migration of El-Hinnawi in the UNEP 1985 report. For Bates this definition does not provide generic criteria distinguishing environmental refugees from other types of migrants and not specify differences between types of environmental refugees. It makes no distinction between refugees who flee volcanic eruptions and those who gradually leave their homes as soil quality declines. For Bates "a working definition of environmental refugees includes people who migrate from their usual residence due to changes in their ambient non-human environment". This definition remains necessarily vague in order to incorporate the two most important features of environmental refugees: the transformation of the environment to one less suitable for human occupation and the acknowledgment that this causes migration. The author establishes a classification of environmental refugees according to the causes of migration. One distinguishes three categories of human migration due to environmental change: (*i*) Environmental refugees due to disasters caused by natural or technological events. Those people are short-term refugees in geographically limited areas. Natural disasters, which include hurricanes, floods, tornadoes, earthquakes or events that made a place inhabitable temporarily or permanently are considered, alongside technological disasters resulting from human choices, as unintentional migration. (*ii*)Environmental refugees due to expropriation of the environment are people who leave their habitat permanently to allow land use. The expropriation of the environment can be due on one hand to economic development such as the construction of hydroelectric dams or roads and, on the other hand, to warfare and the destruction of the environment, strategically displacing the population during war incorporating, for instance, land mines. (*iii*) Environmental refugees due to the deterioration of the environment: the migration of these

people is caused by the anthropogenic degradation of their environment: one talks about environmental migrants. The effect of environmental degradation ripples through the local economy context to affect migration. While disasters and expropriation refugees do not possess any real means to control environmental change, environmental migrants can decide the strategies to cope with environmental change.

A.2 Definition of variables and sources

Variables	Definition	Source
Net migration	The difference between the total number of emigrants minus the number of immigrants divided by the person-years lived by the population	United Nations Population Division
Low, Medium and High educational migration rate	Stocks of migrants from sending countries to the 6 key receiving countries in the OECD (Australia, Canada, France, Germany, UK, USA) by educational level, divided by the stock of adults (+25) corresponding to the same educational level, in the country of origin + The stock of migrants of sending countries.	M. Schiff and M.C Sjoblom (World Bank Databases)
Number of natural disasters	Number of natural disasters (a unique disaster number for each event)	CRED 2010
Number of meteorological disasters (storm)	Number of events caused by small to meso scale atmospheric processes (in the spectrum from minutes to days). The main type of disaster is storms.	CRED 2010

A.2 Definition of variables and sources: continued

Variables	Definition	Sources
Number of hydrological disasters	Number of events caused by deviations in the normal water cycle and/or overflow of bodies of water caused by wind set-up. The main types of disaster are flood and wet mass movement	CRED 2010
Meteorological total affected	Sum of injured, homeless and affected due to meteorological disasters	CRED 2010
Number of climatological disasters	Number of events caused by meso to macro scale processes (in the spectrum from intra-seasonal to multi-decadal climate variability). The main type of disasters are extreme temperature, drought and wildfire	CRED 2010
Meteorological damages	Estimated damages due to meteorological disasters (given in US$)	CRED 2010
Meteorological death	Number of persons confirmed as dead and persons missing and presumed dead due to meteorological disasters	CRED 2010
Hydrological damages	Estimated damages due to hydrological disasters (given in US$)	CRED 2010

A.2 Definition of variables and sources: continued

Variables	Definition	Source
Hydrological death	Number of persons confirmed as dead and persons missing and presumed dead due to hydrological disasters	CRED 2010
Hydrological total affected	Sum of injured, homeless and affected due to hydrological disasters	CRED 2010
Climatological damages	Estimated damages due to climatological disasters (given in US$)	CRED 2010
Climatological death	Number of persons confirmed as dead and persons missing and presumed dead due to climatological disasters	CRED 2010
Climatological total affected	Sum of injured, homeless and affected due to climatological disasters	CRED 2010
Variables	Definition	Source
Surface (km^2)	Country's total area, including areas under inland bodies of water and some coastal waterways	Online World bank WDI
GDP per capita	Gross Domestic Product per capita	Online World bank WDI

A.2 Definition of variables and sources: continued

Population	Total population in the country	Online World bank WDI
Young population	Percentage of population under 14 years old	Online World bank WDI
Population density	Number of inhabitants per km^2	Online World bank WDI
Percentage arable area	Arable area as percentage of total land area	Online World bank WDI
Political rights	Political Rights are measured on a one-to-seven scale, with one representing the highest degree of Freedom and seven the lowest.	Freedom House
Civil war	Dummy variable taking the value 1 for a minimum of 25 battle-related deaths per year and 0 otherwise.	UCDP/PRIO Armed Conflict Dataset

A.3 Summary statistics

Variables	Mean	Stand. Dev.	Min	Max	N
Net Migration	2.42483	8.77183	-57.1	53.4	435
Low education migration rate	0.01284	0.02832	2.4E-05	0.20826	435
Medium education migration rate	0.04552	0.09323	2.7E-05	0.57908	435
High education migration rate	0.17802	0.20317	0.0003	1	435
Number of natural disasters	7.15172	12.7655	0	109	435
Number of meteorological disasters	1.64138	5.11212	0	37	435
Number of hydrological disasters	2.50345	4.86849	0	40	435
Number of climatological disasters	0.82069	1.22382	0	9	435
Meteorological damages	20974.6	179699	0	2890000	435
Meteorological death	59.7517	736.372	0	15100	435
Meteorological total affected	119574	697671	0	6570000	435
Hydrological damages	35995	337246	0	6720000	435
Hydrological death	70.8966	396,384	0	6303	435
Hydrological total affected	926200	7417160	0	1.27e+08	435
Climatological damages	5422.07	49858.3	0	796000	435
Climatological death	4.7954	37.9428	0	558	435
Climatological total affected	247293	2634030	0	5.00e+07	435

A.3 Summary statistics: continued

Surface	662654	1880792	2	1.71e+07	435
GDP per capita	658.911	518.964	56.468	3329.86	435
Population	15.0176	2.12587	9.61581	20.9895	435
Young population	42.6959	5.19297	17.5106	51.771	435
Population density	82.2605	128.162	1.21864	1071.17	435
Percentage arable area	13.7488	13.4038	0.04314	70.1928	435
Political rights	4.88046	1.79078	1	7	435
Civil war	0.22069	0.41519	0	1	435

A.4 Country list

Albania	El Salvador	Liberia	Tanzania
Angola	Eritrea	Madagascar	Thailand
Armenia	Ethiopia	Malawi	Timor-Leste
Azerbaijan	Gambia, The	Maldives	Togo
Bangladesh	Georgia	Mali	Tonga
Belize	Ghana	Mauritania	Tunisia
Benin	Guatemala	Micronesia, Fed. Sts.	Turkmenistan
Bhutan	Guinea	Moldova	Uganda
Bolivia	Guinea-Bissau	Papua New Guinea	Ukraine
Burkina Faso	Guyana	Paraguay	Uzbekistan
Burundi	Haiti	Philippines	Vanuatu
Cambodia	Honduras	Rwanda	Vietnam
Cameroon	India	Samoa	Yemen, Rep.
Cape Verde	Indonesia	Senegal	Zambia
Central African Republic	Iran, Islamic Rep.	Sierra Leone	Zimbabwe
Chad	Ivory Coast	Solomon Islands	
China	Jordan	Sri Lanka	
Comoros	Kenya	Sudan	
Congo, Rep.	Kyrgyz Republic	Swaziland	
Ecuador	Lao PDR	Syrian Arab Republic	
Egypt, Arab Rep.	Lesotho	Tajikistan	

References

[1] Baechler, G. (1999b): Environmental degradation and violent conflict: hypotheses, research agendas and theory building, In M. Suliman: Ecology,Politics and Violent Conflict, Zed Books, London and New York (1999), 76–112.

[2] Barnett, J. and Adger, W. N. (2007): "Climate Change, Human Security and Violent Conflict", *Political Geography,* 26 (6), 639-655.

[3] Barnett, J. and Jones, R. (2002): "Forced migration: the influence of environmental security", *Global Change* 7 (4), 3.

[4] Bates, D. (2002): "Environmental Refugees? Classifying Human Migrations Caused by Environmental Change", *Population and Environment,* 23 (5), 465-477.

[5] Benson, C. and Clay, E. (1998): "The impact of drought on sub-Saharan Economies", World BankTechnical Paper No. 401, Technical report, Washington DC, World Bank.

[6] Bridgman, H. (1983): "Could climatic change have had an influence on the polynesian migrations?", *Palaeogeography, Palaeoclimatology, Palaeoecology,* 41, 193-206.

[7] CEPII data set

[8] Comenetz, J. and Caviedes, C. (2002): "Climate variability, political crises, and historical population displacements in Ethiopia", *Environmental Hazards,* 4, 113-127.

[9] CRED (2010): EM-DAT. Centre for Research on the Epidemiology of Disasters, Brussels: University of Louvain.

[10] Defoort, C. (2008): "Tendances de long terme en migrations internationales: Analyse à partir de 6 pays receveurs", *Population-E*, 63, 285-318.

[11] Docquier, F. and Marfouk, A. (2006): International Migration by Educational Attainment, In C.Ozden and M. Schiff (eds). International Migration, Remittances and Development, Palgrave Macmillan: New York (2006).

[12] Dyson, T. (2006): "On Development, Demography and Climate Change: The End of the World as We Know it?", *Population and Environment*, 27(2), 117-149.

[13] El-Hinnawi, E. (1985): "Environmental Refugees", Technical report, Nairobi, Kenya: United Nations Environmental Programme.

[14] Freedom House dataset

[15] Ghatak, S.; Levine, P. and Price, S. W. (1996): "Migration Theories and Evidence: an Assessment", *Journal of Economic Surveys,* 10(2), 159-198.

[16] Gleditsch et al. (2002): Uppsala Conflict Data Program (UCDP)/Centre for the Study of Civil Wars, International Peace Research Institute, Oslo (PRIO) Armed Conflict Dataset Codebook.

[17] Harris, J. R. and Todaro, M. P. (1970): "Migration, Unemployment and Development: A Two-Sector Analysis", *The American Economic Review,* 60(1), 126-142.

[18] Huang, C. and Su, H. (2009): "Climate change and Zhou relocations in early Chinese history", *Journal of Historical Geography,* 35, 297-310.

[19] Ikeme, J. (2003): "Climate Change Adaptational Deficiencies in Developing Countries: the Case of Sub-Saharan Africa", *Mitigation and Adaptation Strategies for Global Change*, 8(1), 29-52.

[20] IMF (2003): "Fund assistance for countries facing exogeneous shocks", prepared by the Policy Development and Review Departement (In consultation with the Area, Finance and Fiscal Affairs Departements) International Monetary Fund, Technical report, Washington, DC, IMF.

[21] IOM (2007): "Migration and the Environment", IOM (International Organization for Migration), Technical report, International Organization for Migration, Geneva.

[22] IPCC (2007): Fourth Assessment Report: Climate Change 2007: The AR4 Synthesis Report, Geneva: IPCC.

[23] Khasnis, A. and Nettleman, M. (2005): "Global Warming and Infectious Disease", *Archives of Medical Research*, 36, 689–696.

[24] Marchiori, L. and Schumacher, I. (2011): "When nature rebels: international migration, climate change, and inequality", *Journal of Population Economics*, 24, 569-600.

[25] McGregor, J. (1994): "Climate change and involuntary migration: implications for food security", *Food Policy*, 19 (2), 120-132.

[26] Mcleman, R. and Smit, B. (2006): "Migration as an adaptation to Climate Change", *Climatic Change*, 76, 31–53.

[27] Meehl, G. A.; Washington, W. M.; Santer, B. D.; Collins, W. D.; Arblaster, J. M.; Hu, A.; Lawrence, D. M.; Teng, H.; Buja, L. E. and Strand, W. G. (2006): "Climate Change Projections for the Twenty-First Century and Climate Change Commitment in the CCSM3", *Journal of Climate*, 19, 2597-2616.

[28] Meier, P., D. Bond. (2007): "The Influence of Environmental Factors on Conflict in the Horn of Africa", *Journal of Political Geography* (in press).

[29] Meze-Hausken, E. (2000): "Migration caused by climate change: how vulnerable are people in dryland areas?", *Mitigation and Adaptation Strategies for Global Change*, 5, 379–406.

[30] Myers, N. (2005): "Environmental Refugees, an emergent security issue", Paper presented to the 13th Economic Forum, Prague, Czech Republic, 23-27 May 2005.

[31] Naudé, W. (2010), "The Determinants of Migration from Sub-Saharan African Countries", *Journal of African Economies*, 19(3), 330-356.

[32] Ngecu, W. and Mathu, E. (1999): "The El Nino-triggered landslides and their socioeconomic impact on Kenya", *Environmental Geology*, 38 (4), 277–284.

[33] Niasse, M. (2005): "Climate-Induced Water Conflict Risks in West Africa: Recognizing and Coping with Increasing Climate Impacts on Shared Watercourses", paper presented to the International Workshop on Human Security and Climate Change, Asker, Oslo.

[34] Oliver-Smith, A. (2009): Sea level rise and the vulnerability of coastal peoples: responding to the local challenges of global climate change in the 21st century, InterSections No. 7, United Nations University Institute for Environment and Human Security, Bonn.

[35] Perch-Nielsen, S.; Bättig, M. and Imboden, D. (2008): "Exploring the link between climate change and migration", *Climatic Change*, 91, 375–393.

[36] Poston, D.; Zhang, L.; Gotcher, D. and Gu, Y. (2009): "The effect of climate on migration: United States, 1995-2000", *Social Science Research,* 38, 743–753.

[37] Rehdanz, K. and Maddison, D. (2005): "Climate and happiness", *Ecological Economics*, 52(1), 111-125.

[38] Reuveny, R. (2007): "Climate change-induced migration and violent conflict", *Political Geography*, 26, 656-673.

[39] Reuveny, R. and Moore, W. H. (2009): "Does Environmental Degradation Influence Migration? Emigration to Developed Countries in the Late 1980s and 1990s", *Social Science Quarterly*, 90(3), 461-479.

[40] Schrag, S. and Wiener, P. (1995): "Emerging infectious disease: what are the relative roles of ecology and evolution?", *Trends in Ecology & Evolution*, 10 (8).

[41] Schiff, M. and Sjöblom, M. (2008): Panel Data on International Migration 1975-2000, World Bank databases.

[42] Smith, P. (2007): Climate Change, Mass Migration and the Military Response, Foreign Policy Research Institute.

[43] Stark, O. (1991): "The Migration of Labor", London: Basil Blackwell.

[44] Stark, O. and Levhari, D. (1982): "On Migration and Risk in LDCs", *Economic Development and Cultural Change*, 31(1), 191-96.

[45] Stark, O. and Lucas, R. E. B. (1988): "Migration, Remittances, and the Family", *Economic Development and Cultural Change*, 36(3), pp. 465-481.

[46] Stern, N. (2007): "The Economics of Climate Change": The Stern Review, Cambridge University Press.

[47] Swain, A. (Dec.1993): "Conflicts over Water: The Ganges Water Dispute", *Security Dialogue (Oslo)*, 24(4), 429-439.

[48] Swain, A. (Dec.1996): "Environmental Migration and Conflict Dynamics: Focus on Developing Regions", *Third World Quarterly*, 17 (5), 959-973.

[49] Swain, A. (May. 1996): "Displacing the Conflict: Environmental Destruction in Bangladesh and Ethnic Conflict in India", *Journal of Peace Research*, 33 (2), 189-204.

[50] United Nations Population Division (2009): International Migration flows to and from selected countries: the 2008 revision.

[51] Warner, K. (2010): "Global environmental change and migration: Governance challenges", *Global Environmental Change*, 20 (3), 402-413.

[52] Washington, R.; Harrison, M.; Conway, D.; Black, E.; Challinor, A.; Grimes, D.; Jones, R.; Morse, A.; Kay, G. and Todd, M. (2006): "African Climate change: taking the shorter Route", *Bulletin of the American Meteorological Society*, 87, 10, 1355-1366.

[53] World Development Indicators, World Bank database.

Chapter 2

"Barcelona or Die":Understanding Illegal Migration from Senegal

2.1. Introduction

Illegal migration from the developing world to rich countries raises many important issues at the political, economic and humanitarian levels. Of 214 million migrants in the world, about 20 to 30 million, i.e. 10 to 15% of migrants, are undocumented. Moreover, an increase of this proportion is expected in the following years (IOM, 2010)[1]. Since the Autumn of 2005, people in Europe have regularly been the witnesses of events related to illegal migration coming from Africa such as the Ceuta and Melilla tragedy[2] or images in

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[1]International Organization for Migration

[2]Ceuta and Melilla are two Spanish enclaves in Morocco. In 2001, the Spanish government constructed fences to stop illegal migrants crossing these borders. During the Autumn of 2005, many illegal migrants

the media of boat-people disembarking on European coasts on news. Such events show how strongly illegal migrants are motivated to leave their country with the hope of finding a better life condition. The phenomenon of illegal migration is not new. New methods of illegal migration are continually being developed to combat tightening immigration policies in receiving countries. Before 1999, illegal migrants from Africa used to go to Maghreb countries via the desert in order to reach Europe. Since 1999, tightened border control at the Straits of Gibraltar has increasingly driven illegal migrant flows to use boats to reach European coasts such as Lampedusa, Sicily or the Canary Island (De Hass, 2006; Adepoju and Afrikainstitutet 2008). We are interested in the Senegalese context because many of these boat-people come from Senegal which has been severely affected by illegal migration. The motto of thousands of Senegalese migrants who try to migrate illegally is "Barsa wala Barsakh" which means in Wolof[3] "Barcelona[4] or Die: we prefer dying by remaining in Senegal whether we cannot migrate to Europe or to a rich country". To give an idea of the scope of the phenomenon, among the 30 000 illegal migrants that arrived in the Canary Islands in 2006 half of them were Senegalese and in the same year, of 7 000 African illegal migrants who died during the crossings almost 1 000 were Senegalese.[5]

Illegal migration has above all been studied in the context of Mexico and the United States (see for instance Hanson and Spilimbergo, 1999; Hanson, 2006; Orrenius, 2004; Orrenius and Zavodny, 2005; Gathmann, 2008). Very few studies have been made on illegal migration from Africa.[6] Our main aim in this chapter is to contribute to fill the

mainly coming from Sub-Saharan Africa and trying to reach Spain were killed or injured by border controllers.

[3]Wolof is one the main languages spoken in Senegal.

[4]Barcelona representing here the European Eldorado.

[5] Source : Asociación Pro Derechos Humanos de Andalucía, www.apdha.org.

[6]See for instance, Chiuri et al. (2007) that document the characteristics of illegal migrants by using a sample of individuals coming among others from African countries and entered Italy illegally during

gap in the literature by examining the factors related to illegal migration. In other words, we aim to investigate why some people are willing to risk their lives by trying to migrate illegally. To understand the mechanisms behind this, we conducted a tailor-made survey in Senegal from November 2006 to April 2007 and collected a wealth of information about the intentions and attitudes of people on illegal migration. Our survey also elicits information on various socio-demographic and economic characteristics of individuals including the potential destinations and the financial cost of migration that the individuals perceive.

Since we get intentions, it means that people in our sample who are willing to migrate legally or illegally are potential migrants who could realize their plan and migrate in the future as well as they could stay in Senegal and never migrate. In both cases intentions of potential migrants give an indication of their motivations. Social psychology theories such as the theory of reasoned action (Ajzen and Fishbein, 1980) and the theory of planned behavior (Ajzen, 1991; Ajzen,1988) argue that intentions are the first determinant and a good predictor of behavior. According to Ajzen (1991, p.181), "Intentions are assumed to capture motivational factors that influence behavior; they are indications of how hard people are willing to try, of how much of an effort they are planning to exert in order to perform behavior". These theories claim that a strong intention has a high probability to be transformed into behavior if the individual evaluates a positive self-performance of a particular behavior (this condition is called attitudes toward behavior), perceives that social norms are favorable to this behavior (subjective norms) and is able to perceive the difficulty to perform this behavior (perceived behavioral control). However, Manski (1990) argues that intentions data have to be used carefully because they may not necessarily

2003. In the particular case of Senegal, Fall (2007) and Mbow (2008) made some sociological studies about this issue.

predict behaviour. The mismatch between intention and behaviour can be due to the differences between information available when the intention is formulated and when the behavior is determined. Bertrand and Mullainathan (2001) also claim being careful about using subjective variables but at the same time they specify that these variables are useful for explaining differences in behavior accross individuals. Moreover, in the field of migration, Dalen and Henkens (2008) show that migration intentions are a good predictor of future migration flows. In the case of illegal migration, we argue that it is important to have some evidence using intentions data. Intentions of migration and of illegal migration in particular are a good indicator of how people are frustrated with the life condition in their country of origin. Moreover, in general illegal migrants become no more observable once they arrived in the host country without being apprehended. Then, intentions data are valuable in this specific case because they help to elicit motivations and to have a better comprehension of this phenomenon which is useful, for example, to adapt migration policies both in the sending and the receiving countries. It is therefore important to know how these intentions to migrate illegally are formed.

From data in our survey, we estimate various simple probit models to examine the determinants of the probability that an individual will choose to migrate illegally. We are first interested in the relationship between individual characteristics and the willingness to migrate illegally. We later examine the role of illegal migration prices, expectations, relatives who have already migrated and tight immigration policies on the willingness of individuals to migrate illegally.

Our results can be summarized as follows: first, illegal migrants are willing to accept a substantial risk of death (25% at the median) and tend to be young, single and with a low

level of education. Second, high illegal migration prices are negatively correlated with the likelihood to migrate illegally. This result suggests that the poorest are not able to migrate illegally. Third, biased expectations of potential migrants play an important role in the intention to migrate illegally. This result highlights the fact that people may base a risky decision on wrong information. Fourth, there is a positive relationship between migrant networks and illegal migration intentions which may be due to the fact that relatives who have already migrated help to reduce the costs associated with illegal migration to the host country and furthermore can sometimes give a less than accurate information of their living conditions which serves to increase the desire of potential illegal migrants. Fifth, tight immigration policies may not be effective because they deter more potential legal migrants than potential illegal migrants. Sixth, some particular destinations are more correlated with illegal migration than others. Historical links, cultural proximity and language matter less in the choice of the destination country of potential illegal migrants.

The remaining part of the chapter is organized as follows: the next section presents the existing literature on migration intentions and triggering factors of illegal migration such as expectations, networks, tight immigration policies and migration cost. Section 2.3 presents the data and descriptive statistics obtained from our survey. The estimation strategy and the empirical results are presented in Section 2.4 whereas Section 2.5 concludes.

2.2. Literature

The aim of this chapter is to analyze the intentions to migrate illegally. We draw on literature on this topic and on some triggering factors such as expectations, migrant

networks, immigration policies and migration costs[7] that we think play an important role in the willingness to migrate illegally.

The determinants of migration intentions have already been studied in the literature. Migration intentions are driven by certain socio-demographic factors such as gender, age, level of education, place of origin of migrants or the presence of friends and relatives in the destination place (Dalen et al., 2005a; Fouarge and Ester, 2007; Zaiceva and Zimmermann, 2008; Burda, 1993; Epstein and Gang, 2006). Moreover, intentions to migrate are determined by the economic conditions in the country of origin such as the level of income inequality (Liebig and Souza-Poza, 2004) or the social conditions in the receiving country such as the level of xenophobia (Friebel et al., 2011).

It is also shown in the literature that migration intentions are often motivated by great expectations towards the living standards at the destination (Dalen et al., 2005a; de Jong, 2000). These high expectations are often unrealistic and can lead to a negative migration experience (Knight and Gunatilaka, 2010; Sabates-Wheeler et al., 2009). Nevertheless, there is no consensus in the literature about the role of expectations regarding migration; some studies argue that the role of over expectations on migration decision needs to be put into perspective. For instance, McKenzie et al. (2012) find that contrary to the general understanding suggesting that over expectations increase the pressure to migrate, potential male migrants from Tonga to New Zealand underestimate both their likelihood to find a job and their earnings. The main explanation underlining this is that these migrants form their expectations on information given by old cohorts of migrants. They also find that conditional to the size of the network those having relatives such as uncles or

[7]The role of migration costs on the intention to migrate can be explained through the role of expectations, networks and immigration policies.

cousins in New Zealand are more misinformed. These people expect lower earnings than those having no relatives or close family in New Zealand.[8] In our chapter, we also measure income expectations and how they affect the willingness of individuals to migrate. We use a direct question by asking to potential migrants "How much are you expecting to earn each month in the destination country?" It is important to note that our measure for expectations differs from the measure of McKenzie et al. (2012). These authors measure the probabilistic expectations of migrants by estimating the quantiles and moments of interest from the subjective distribution of earnings in the destination country conditional on working. But even though we do not use the same measure of expectations, it is very likely in the specific context of Senegal to assume some over expectations of migration returns from potential migrants. Historical, sociological and economic factors can explain our assumption. First of all, Senegal has a long tradition of migration in West Africa and also in Europe. Senegal provided "Tirailleurs"[9] to France during the First World War (Riccio, 2005; 2008). From the sixties, Senegalese migration to France was mainly explained by the need for workers in the reconstruction in France (Riccio, 2005;2008; Manchuelle, 1997). According to Fall (2003), international migration from Senegal to Northern countries has been growing since the eighties. This trend has accelerated with new destinations, such as Italy or Spain which raise a great interest since the coming of the "Modou-Modou". This term at first referred to seasonal workers looking for supplementary incomes in big cities such as Dakar. Since the beginning of the nineties, it has applied to all Senegalese international migrants. It was at this moment that Senegalese migration flows increased

[8] According to Mckenzie et al. (2012), migrants lower and do not reveal the real amount that they earn in order to reduce the pressure regarding remittances coming from their extended family.

[9] "Tirailleurs sénégalais" is a generic term to design Sub-Saharan Africa soldiers who belonged to the French Colonial Army.

considerably, in particular due to the degradation of the economic context. Second, in Africa and more specifically in Senegal many households with good life conditions have one or many family members who have migrated. Migrants send remittances[10] and invest in buildings, business and social services for the community (Beauchemin and Shoumaker, 2009; Melly, 2011; Kane, 2002; Diatta and Mbow, 1999). These transfers and investments give them an important economic power and signal a better life abroad which affects the intentions and expectations of individuals belonging to the non-migrant families in the local communities (Dalen et al., 2005b). Third, remittances demonstrate family attachement and testify to a successfull migration. They allow to the migrant family to signal success, for instance, through the construction of private houses or at family celebrations (Riccio, 2005; 2008). This would generate deprivation feeling among other members in the community who aspire to similar standards of living and who may be motivated to migrate illegally due to the high social pressure of having a lower social status.

Migrant networks, particularly family and friends' relatives who have already migrated legally or illegally, are considered as another trigger of illegal migration. The literature shows that migrant networks are the main source of information and a demonstrative example. Migrant networks measured as the stock of migrants in the host country are a crucial determinant of migration flows and of their variability (Perdersen et al., 2008; Beine et al., 2011). These networks contribute to a reduction in the various costs related to

[10]We could also refer here to the role that the relative deprivation of individuals in their community plays on migration (Runciman, 1966; Stark and Taylor, 1989). Remittances sent to the migrant's family increase the desire to migrate of non-migrants families by changing the income distribution and by creating inequalities that can induce a higher propensity to migrate (Stark, 2006; Stark et al., 2009). Moreover, remittances associated with migration help to reinforce the social status of the migrant's family in the community (Azam and Gubert, 2005). Moreover, in Sub-Saharan Africa, Senegal is one of the main recipient countries of remittances which represent 9.3% of GDP (Ratha et al., 2011).

migration (Carrington et al., 1996; Winters et al., 2001, Munshi, 2003; Bauer et al., 2005). This is particularly true for the most vulnerable population. For instance, Mckenzie and Rapaport (2007) find that a small network increases inequalities because only households from the middle-class and the upper-class can bear migration costs. However, a larger network induces lower migration costs which reduces inequality and the possibility for poorer households to migrate. In the case of illegal migration, literature also suggests that migrant networks play an important role in the decision to migrate illegally (Hanson, 2006). Studies of illegal migration from Mexico to the U.S. find that networks help individuals to get assistance to find a job more easily, to learn the information about how to cross the borders illegally and to obtain the financial cost of migration through informal credit mechanisms between individuals (Massey and Espinoza, 1997; Singer and Massey, 1998; Orrenius and Zavodny, 2005; Dolfin and Genicot, 2010).

We also assume that tight immigration policies in the destination countries affect the intention to migrate illegally. The illegal migration market works as a "classical market" that suggests a negative correlation between the price of illegal migration and illegal migrants flows. One the one hand, a tight border enforcement increases the likelihood of being apprehended which raises illegal migration prices. These higher illegal migration prices decrease in turn the demand for smugglers' services (Singer and Massey, 1998; Gathman, 2008). On the other hand, stricter immigration policies often have some pernicious effect on illegal migration. For instance Orrenius (2004) and Gathman (2008) show that border enforcement actually worsens the situation by playing into the hands of smugglers who raise their prices. Moreover, stricter border controls force illegal migrants to change their itinerary which makes their journey longer and more dangerous. Finally,

these authors conclude that only a small deterring effect is achieved by the enforcement of border controls between Mexico and the U.S.. More restrictive immigration policies decrease the inflows of illegal migrants. However, at the same time illegal migrants that have to face higher migration costs increase their migration duration in the host country which makes the net effect on migration flows unclear (Angelucci, 2012; Borodak and Miniscloux, 2009). This unclear effect is also related to the type of immigration policies. Friebel and Guriev (2006) argue that stricter deportation policies increase illegal migration flows and negatively affect the skill composition of immigrants whereas stricter border controls decrease the overall flows of immigrants and contribute to develop the debt contracts between intermediaries and illegal migrants.

The choice of destination country can also explain the method of migration to a country and can be used as a proxy for expectations, migrant relatives, migration prices and immigration policies. Intuitively, migration prices depend on the destination. The location choice of immigrants is highly correlated with the income opportunities (Konseiga, 2007; Mayda, 2010, Ortega and Peri, 2012); the presence of migrant networks (Jaeger, 2000; Chiswick et al., 2005; Epstein, 2002; Bauer et al., 2005; Epstein and Gang, 2006); the geographical proximity but also the social proximity measured by the language proximity or the ethnic background (Fafchamps and Shilpi, 2013). It is also shown in the literature that immigration policies influence the choice of the destination country (Pena, 2009; Bertoli et al; 2011). For instance, Ortega and Peri (2012) find that a tightening of entry laws decreases migrant flows to a country just one year after their application.

2.3. Data

2.3.1. The Survey

In order to examine the intentions and possible triggering factors of illegal migration we conducted a tailor-made survey in Senegal. This study was conducted in Dakar and was exploratory. It does not allow us to generalize our results to all the Senegalese population. However, since illegal migration from Africa has not been greatly studied, the original data set obtained from this survey can help to fill the gap in the literature and give us the opportunity to understand this phenomenon further.

A random sample of individuals was interviewed between November 2006 and April 2007. Prior to the main survey, a pilot study is conducted to be able to adjust for possible biases.[11] There are four sections of the survey: first, we elicit a wealth of information about the socio-demographic and economic characteristics of the individuals. Second, we elicit the willingness or intentions of individuals to migrate legally or illegally and the motivations behind it. Third, the individuals are asked a detailed battery of questions about the preferred destinations. Fourth, we are interested in the willingness of the individuals to risk their lives or to take financial risks, for example, by paying a smuggler.

The sampling design was made considering various diversities in Dakar simultaneously. 400 randomly chosen individuals were interviewed in different neighborhoods. The survey was conducted in major five regions of Dakar. The first one is the University Campus and its surroundings. Many people belonging to the middle class live in this neighborhood. The second neighborhood is Fass, Medina and Geule-Tapee and the third one is Guediawaye. The second and the third regions are mainly some popular neighborhoods.

[11] See Appendix A.1 for the details of the questionnaire.

The fourth level of randomization is Sandaga which is one of the main areas shopping in the city center. Many people coming from the rural sector work there. For some of them, Dakar is the final destination but for many the city is a temporary place for preparing further migration by working in low-paying jobs. Finally, the fifth region was the main departure beaches for illegal migrants namely Kayar, Thiaroye, Yarakh and Yoff. Since our aim is to explain the illegal migration intentions, the stratification is made in order to identify people having a high propensity to migrate. Consequently, we did not include rich regions in Dakar because it is very unlikely that people living in these neighborhoods have to consider migration and illegal migration in particular.[12]

In our survey, we ask people directly: "Are you willing to migrate?" to measure their intentions. 92% of our sample, i.e. 367 individuals, answer yes (Table 2.1). We focus our analysis on individuals willing to attempt legal or illegal migration. To those who wish to migrate we ask the question: "If you are not able to migrate legally, are you willing to migrate illegally?"[13] Among the 367 individuals who wish to migrate 222 report that they would be able to only migrate legally and 145 report that they would be able to migrate illegally.

The proportion of people who consider migration is high (92%) and needs to be discussed. We have some variation across regions where we conducted the survey and the

[12]These people are in most cases highly educated, much wealthier than the average population and have good life conditions in Senegal. Moreover, when they have to go abroad they are able to provide reliable documents to consular officials and do not have an issue with travelling legally.

[13]We ask the question in this form, because we assume that if people have the opportunity to migrate legally they will naturally go towards this type of migration. In the Senegalese context, it is very likely that people attempting illegal migration have the perceptions that, because of their low level of qualifications, the instability or the weakness of their professional situation, obtaining legitimate documents would be difficult for them. Attempting legal migration would be a waste of time and therefore, they will restrict themselves to ask for legal documents.

proportion of people who wish to migrate is high in all these areas. First of all, it does not mean that all these people will attempt migration. However, some of them will do so. As mentioned above, we measure the intentions of people and we call them potential migrants. In fact, this high number is a very strong indication of the degree of frustration about the economic conditions faced by the average Senegalese individual.

2.3.2. Statistics

[TABLE 2.1 HERE]

Table 2.1 gives the summary statistics.[14] Men represent 88% of our sample. This proportion is the same for potential legal and illegal migrants. People reachable in the different neighborhoods were mainly male which is consistent with our aim to reach the population that can have a high intention to migrate. Migration in Senegal is indeed a phenomenon that mainly affects men. In our sample, there is no difference between men and women in the willingness to migrate illegally. The average age is 26 years old and the average age of potential illegal migrants is slightly lower (24 years) than that of potential legal migrants (27 years). The proportion of married people among potential legal migrants represents the double (32%) of that among potential illegal migrants (17%). This suggests a negative correlation between the marital status and the intention of illegal migration. 75% of people interviewed have at least one adult male as dependent and more than 80% of them have at least one male child, one female child or one female adult as dependent. These proportions are higher for potential legal migrants than for potential illegal migrants. The average level of education is the secondary level and 27% of people

[14] See Appendix A.2 for the definition of the variables.

have reached this level. But it is interesting to see that 55% of potential illegal migrants have a low level of education whereas they represent 33% of potential legal migrants. Only 5% of potential illegal migrants have a university level which is five times less than in the population of potential legal migrants. 57% of people live in a house that belongs to them or to their family. This figure does not vary much according to the legal or illegal consideration of migration. Among the potential illegal migrants we find more people belonging to the Mouride brotherhood[15] (54%) than among the potential legal migrants (39%). This religious dummy may therefore play a role in the willingness to migrate illegally.

The average monthly wage in Senegal approximated by monthly expenditure[16] is estimated at 73 604 Fcfa (112 Euros) for potential illegal migrants and is slightly lower than potential legal migrants (77 684 Fcfa i.e. 118 euros). The expected wages are much higher both for potential legal and illegal migrants. However, the average amount given by the first one is higher (1.850.505 Fcfa i.e. 2821 Euros) than the amount given by the second one (1 141 931 Fcfa, i.e. 1739 Euros). Potential illegal migrants have on average more relatives (86%) than potential legal migrants (66%). 79% of potential illegal migrants report that they will not give up on migration if there is a tightening of immigration policies in the destination countries whereas the figure is less among potential legal migrants (62%). Our summary statistics show that the preferred destinations of potential illegal migrants are in the first position Spain, followed by Italy, in the third position the U.S. and France

[15]Mouride is a dummy equal to 1 if people belong to this religious brotherhood. Senegal is composed of 94% of Muslim people, 5% of Christian people and 1% of Animist people. A lot of Muslim people are affiliated to different brotherhoods headed by a spiritual guide and Mouride is one of the most important brotherhoods in Senegal.

[16]Expenditure are considered more reliable and less biased than the level of the income because people answer more readily about this variable.

comes in the fourth position. 41% of potential illegal migrants prefer Spain versus only 18% for potential legal migrants and 26% of potential illegal migrants prefer Italy versus 15% of potential legal migrants. Whereas 16% of potential illegal migrants prefer the U.S. versus 31% of potential legal migrants and 3% of potential illegal migrants prefer France versus 16% among potential legal migrants. The method of migration appears then also different according to the choice of the destination country.

[TABLE 2.2 HERE]

During the survey, we observed that there are three ways to migrate. The first method consists in going legally by applying directly for a legal visa and paying the airfare. This is what we call the "visa method". The second method is called "canoe method". It involves paying a fee to a smuggler and using boats or routes towards Maghreb countries in order to attempt to get into various destination countries illegally often Spain, Italy or France. Finally the third method is called the "embassy method". It consists in corrupting someone who is linked to consular sections in Dakar to get legitimate documents. We consider the "canoe" and the "embassy" methods as illegal. For a given destination country, we have also the responses of our sample of potential migrants concerning the prices of different migration methods. Table 2.1 shows the average price of all destinations for each method of migration. Due to the nature of the type of journey offered by the "canoe method", its probability of success is much lower than with the embassy method. Therefore, the price of this method is lowest (419 090 Fcfa i.e. 638 euros on average for all the destinations) than the embassy method (3 071 603 Fcfa, i.e. 4678 Euros) that gets the same probability of success as the legal method. According to the answers of the interviewed people, the visa method price is on average equal to 829 785 Fcfa, i.e.

1264 Euros. Table 2.2 presents the average prices for each method of migration and each destination country. These prices are reported directly by potential migrants who generally have good information on the illegal migration prices. We compare these prices with the ones given by press reports, discussions with some migrants, people who have made some attempts. They correspond to the real prices in the market except for the "visa method". The "visa method 1" corresponds to the response of potential migrants and the "visa method 2" corresponds to the prices calculated from the average cost of the airfare according to the destination country added to the visa fees. For most individuals the likelihood of migrating legally is low which implies that they are misinformed about the legal market and they do not know the real "visa method" price.

[FIGURE 2.1 HERE]

77% of potential illegal migrants reported that they are willing to risk their life in order to migrate. Figure 2.1 shows the distribution of their probabilities of death. When we asked them how likely they were to die if they tried to illegally migrate to the preferred destination, potential illegal migrants reported that they are willing to accept a 25% risk of death at the median, which is substantial. These figures illustrate the attitudes of illegal migrants towards risk and are demontrative of their strong determination to leave their home country whatever the risks.

2.4. Econometric analysis and Results

2.4.1. Model specification

Our main interest is to explore the relation between various characteristics and the likelihood of illegal migration intentions. In order to examine empirically this we estimate various simple probit models. The estimation function is specified as follows:

$$m_i = \begin{cases} 1 \; if \quad x_i\beta + z_i\theta + \alpha_r + \epsilon_i > 0 \\ 0 \; if \quad x_i\beta + z_i\theta + \alpha_r + \epsilon_i \leq 0 \end{cases} \tag{2.1}$$

Where m_i is the binary dependent variable equal to one if the individual i reports a possibility for illegal migration and 0 otherwise; x_i is the vector of socio-demographic and economic characteristics such as the logarithm of the monthly wage earned in Senegal per capita, approximated by the average monthly expenditure of the individuals divided by the number of dependents[17], gender, age, marital status, education level, gender of dependent children (dummy equal to one if the individual has male or female dependent child), gender of dependent adults (dummy equal to one if the individual has male or female dependent adult), home occupation status (dummy equal to one if the individual and his family live in their own home) and indicator variables for religion and ethnic groups. β is the vector of parameters to be estimated.

[17]We divided the average monthly expenditure of the individuals by 1+ the number of dependents and also the foreign expected wage by 1 + the number of dependents to take into account the burden of responsibilities that may influence the way to migrate.

Equation (2.1) also includes another vector of variables z_i that we will included in the estimation to investigate the hypotheses discussed in the second section. These variables are related to the prices of migration, expectations of migrants, migrant networks (proxied by the existing relatives of migrants abroad), immigration policies and choice of destination. θ is the vector of parameters to be estimated for these variables. As mentioned in the third section, there are mainly five regions in Dakar where we collected our data. In order to capture unobserved regional characteristics, we control equation (2.1) for five regional dummies (α_r). Additionally, the error term ϵ_i is assumed to be normally distributed with zero mean and unit variance due to identification.

2.4.2. Main Results

In this section we present how standard socio-demographic and economic characteristics of individuals are correlated with the probability to migrate illegally. The results of estimates are presented in Table 2.3.

[TABLE 2.3 HERE]

The variable "married" is significantly different from 0 at a level of 1% and negative in all specifications (Column 1 to Column 4). Therefore, being married decreases the probability to migrate illegally compared with a non-married individual. The main reason is that married people have more familial responsibilities and ties and are less willing to take risks compared to single people. The consequences of attempted illegal migration will not only affect them directly but they will also have some effects on their close relatives such as their spouses.

The variable age is significant at a level of 5% and negative. Younger is an individual higher is his likelihood to migrate illegally. Young people are less risk averse than elderly people (see for instance Dohmen et al., 2005). Then, regarding the financial risk and the high uncertainty related to illegal migration, it is very likely to find more young people among potential illegal migrants.[18]

The dummy "Mouride" is positive and significant which means that belonging to this brotherhood increases the propensity to migrate illegally relative to the other religious category. There are two main explanations of this effect: first, historically and culturally "Mouride" people are great travelers. Moreover, the work ethic is very important in their vision and they are known to be hard workers. In their ideology, it is important to find a job where it is possible. Second, and it is probably the main reason, relatives are essential in the Senegalese migrants' socialization (Fall, 1998) and "Mouride" people constitute an important religious group with a big network abroad. This is an illustration of the network effect on the illegal issue that we are going to develop and specify in the second part of the empirical analysis.

In Column 2, the logarithm of the monthly wage earned in Senegal per capita has a positive sign but it is not significant. This variable is considered as a push factor but it does not affect the likelihood to migrate illegally. The level of income in Senegal is then not sufficient to explain illegal migration.

In Column 3, we introduce the level of education and in Column 4 we introduce both the logarithm of the monthly wage earned in Senegal per capita and the level of education as explanatory variables. Our results concerning the level of education show that the

[18]We also run the estimates with the variable age and its squared but we did not find any significance of this variable.

higher the education level of the individual the less is his willingness to migrate illegally. In other words, highly educated people have a reduced probability to form intentions for illegal migration which suggests a negative selection of illegal migrants in the case of Senegal.[19] People who have a secondary or a higher level of education, respectively decrease by 12.4% and 33.2% (Column 4) their probability to attempt illegal migration compared with those who just have a low level of education. Educated people have more opportunities to find a good job, to get out of poverty and above all to get legitimate documents and to migrate legally. According to Chiswick (1999), visa rationing due to migration restriction can be based on selection criteria such as education or the qualifications of migrants and influences a positive self-selection of migrants which enhances their labor market success. But this favorable self-selection of migrants is less important for illegal migrants who often have a low education level. Moreover, illegal migrants because of the risk of apprehension and deportation tend to invest in very little human capital.

Gender has a positive sign but it is not significant. The dummies for the gender and the age of dependent people are not significant. Living in a house owned by the individual or his family has a negative sign in all estimates which means that it decreases the willingness to migrate illegally but the result is not robust when we control for the logarithm of the monthly wage per capita earned in Senegal.

[19] In the literature there are essentially two visions about the selection of migrants according to their education level. Borjas (1987) argues that there is a negative selection in poor countries where the less skilled have a higher propensity to migrate whereas Chiquiar and Hanson (2005) and Orrenius and Zavodny (2005) find a positive or an intermediate selection on observable characteristics of education level of Mexican migrants. Orrenius and Zavodny (2005), for instance, show that changes in the migration determinants affect the self-selection of undocumented workers from Mexico to the U.S.. According to these authors, better economic conditions in the U.S. and in Mexico lead to the migration of low-skilled undocumented workers whereas bad economic conditions in Mexico and stricter border enforcement are associated with a higher positive selection among Mexican migrants.

2.5. Discussion

In this part, we examine more deeply the relation between the socio-demographic and economic characteristics and illegal migration intentions and we analyze the role of the triggering factors which are discussed in Section 2.2. We study how the price of migration, expectations, immigration policies and presence of relatives in the destination countries are correlated with the illegal migration intentions of people in Senegal.

2.5.1. Prices of Illegal Migration

[TABLE 2.4 HERE]

Table 2.4 presents the estimates of the average price according to the destination country of the visa method 1,[20] the canoe method, the embassy method and all the prices without any distinction about the method of migration. For each method of migration, the price is calculated as the average price for each destination. The variable migration prices represents the entirety for all the destinations and without any distinction about the method of migration. These regressions control for all variables used in the specifications above. The variable log visa price (Column 1) is positive but not significantly different from 0. For people who are willing to migrate illegally the legal price will not influence their decision because it is very likely that these individuals know their low probability of getting legitimate documents due to their socio-economic characteristics. Then, a high or a low legal price would not be a key element of their willingness to migrate illegally. The price of illegal migration methods namely the canoe method (Column 2) and the embassy

[20]We use in the estimates the average price of each destination of the visa method 1 instead of the visa method 2 because it is on this price that individuals will base their willingness to migrate.

method (Column 3) are significant and negative. However, when we put these both prices together (Column 4) the variable log canoe price remains negative but not significant. One can assume that in the illegal migration market the levels of price of one illegal method will influence the levels of price of the other. The negative relationship between the price of illegal migration and the willingness to migrate illegally can be explained by the fact that migration and illegal migration in particular are expensive for people from the working class or even for a Senegalese from the middle class. The price of the embassy method for instance is highly expensive and very discouraging for the poorest illegal migration candidates. The result of illegal migration prices is confirmed in Column 5 where we look at the role of all migration prices without any distinction about the method of migration. This variable has also a strong negative effect on the willingness to migrate illegally.

2.5.2. Expectations

[TABLE 2.5 HERE]

Columns 1 and 4 of Table 2.5 show the role of expectations measured by the log of the expected monthly foreign wage per capita on the likelihood to migrate illegally. A higher expected wage in the destination country per capita is positively correlated with the consideration about illegal migration. This supports the hypothesis that high expectations lead to an increased willingness to migrate illegally. We argue that these expectations are often based on the perceptions of migrants about the earnings of their family and friends' relatives living abroad.

[FIGURE 2.2 HERE]

[FIGURE 2.3 HERE]

[FIGURE 2.4 HERE]

Figures 2.2, 2.3 and 2.4 compare the distributions of expected monthly foreign wages and the perceptions of family and friends' relatives wages with potential illegal migrants, potential legal migrants and the whole sample of potential migrants. In the three cases we can see that both distributions are similar. When we look at the comparison between the expected foreign wages of potential illegal migrants and their perceptions of family and friends' relatives wages (Figure 2.2), it appears that the expectations of potential illegal migrants are very close to their perceptions even if they are lower. The average expected monthly wage of illegal migrants is equal to 1 141 931 Fcfa (1740 Euros) and their median expected monthly wage is 800 000 Fcfa (1218 Euros).[21] For all potential migrants the average relatives monthly wage is estimated at 1 305 055 Fcfa, i.e. about 1991 Euros whereas their expected monthly wage is estimated at 1 567 466 Fcfa, i.e. about 2390 Euros.[22] On average, potential migrants in general and potential legal migrants in particular expect to earn more than their relatives who have migrated before.

[21]For example, according to the French National Institute of Statistics (INSEE), the monthly average available income for a French household (composed of one individual) from the middle class is estimated between 1100 Euros and 1600 Euros in 2006. The median living standards is estimated at 1470 Euros per month and 50% of French households have a monthly available income lower than 2260 Euros.

Sources:http://www.insee.fr/fr/themes/detail.asp?reg_id=0&ref_id=ir-erfs2006&page=irweb/erfs2006/dd/erfs2006_men.htm#ERFS2006-AN-MEN-DIS

http://www.insee.fr/fr/ffc/docs_ffc/ref/revpmen09b.PDF

[22]The gap between the expected wages of potential legal migrants and their perceptions is more important than for potential illegal migrants. Potential legal migrants expect to earn more than their relatives (Figure 2.3). This is due to the fact that illegal migrants are aware of their condition of illegality and know that they will earn less compared to a situation where they would be legal migrants.

2.5.3. Networks and information

Many respondents already have relatives in their preferred destination country and have an idea concerning the wages that they earn. The variable relatives is a dummy equal to one if the individual has members of his family, close friends or relatives who have migrated. The relatives and more largely the migrant networks increase the willingness to migrate illegally (Table 2.5, Column 2 and Column 4). The information about expected foreign wages often comes from the perceptions of migrants about their relatives' earnings. Family and friends' relatives have a positive influence on the willingness to migrate illegally. They help to reduce migration costs but they also give a certain standard of living to their family left behind, they give them information about life abroad which may be true or not and can let them believe that success is guaranteed with migration.

2.5.4. Migration Policies

The variable tightening of immigration policies is a dummy equal to 1 if the potential migrant does not give up on migration if the immigration policies in the host countries are tight. A tightening of immigration policies means that the conditions to enter the host countries are made more difficult and more restrictive. These conditions can be related to the quotas of immigrants, their level of education, their skills or to stricter border controls of the host countries. This variable has a significant and positive sign (Table 2.5 Column 3 and 4) which means that tight immigration policies for entering host countries have a counterintuitive effect on the propensity to migrate illegally. It deters more those who are willing to migrate legally than potential illegal migrants. This result suggests that tight

immigration policies may be less efficient and can incite potential migrants to turn to illegal methods such as paying a smuggler or corrupting officials to get legal documents.

2.5.5. Destinations

[TABLE 2.6 HERE]

Destinations dummies are used to look at the role of the choice of the preferred destination country on the willingness to migrate illegally. We replace the four interest variables by countries dummies because the choice of the destination countries mainly depends on the opportunities, the possibility of finding a job and therefore on the expected wage in the host country, the presence of relatives who have migrated to this country and the perception of the flexibility of the immigration policies in the host country. We exclude the migration prices which are estimated according to the destinations to avoid a multicolinearity issue. Results in Table 2.6 show that people who desire to go to Spain (Column 1) or Italy Column (2) have a higher likelihood of migrating illegally. People who have as preferred destination countries the U.S. (Column 3), France (Column 4), or the United Kingdom (Column 5) have a lower probability to migrate illegally.[23] There are many explanations for these results. First, Spain and Italy are geographically more accessible and therefore less expensive than France or the U.S. by using illegal methods such as the "Canoe method". For instance, Hanson (2006) argues that the geographical proximity between the U.S. and Mexico makes illegal migration between those two countries easier. The second explanation is the size of the migrants network which is very large in those two countries. OECD statistics (2010)[24] show that the inflows of Senegalese people in Spain

[23] Canada (Column 6) and the destination Other (Column 7) are not significant.

[24] www.stats.oecd.org

and Italy have increased between 2006 and 2009 whereas they have remained stable in France.[25] Finally, the third likely reason is the perception of different immigration policies by migrants. For illegal migrants historical links, cultural proximity and language have less importance in the choice of the destination country. Indeed, despite historical and cultural links between France and Senegal, [26] many individuals report during the survey that the political line on migration to France is more difficult.[27] If migrants have the choice between different countries they will choose the one with less restrictive immigration policies and where it is easier to enter. It does not necessarily mean that these people will give up on migrating illegally. Our results are similar to those of Orrenius (2004) and Gathman (2008). In fact, these authors argue that stricter border control changes the place of crossing and in our case we find that stricter migration policies for entering host countries can modify the choice of the destination countries without eliminating the willingness to migrate illegally.

2.6. Conclusion

The novelty of this chapter is twofold. First of all, it presents results from a tailor-made survey among the potential migrants in Senegal. Second, it investigates how the intentions

[25]According to Banerjee (1992) and Epstein (2002) we can assimilate this type of behavior by herd behavior. Decision makers who are the migrants in our case base their willingness on information given by the acts of previous decision makers represented by relatives in the host countries. These migrants would act differently if they had private information. Moreover, illegal and unskilled migrants are more dependent of network externalities than legal and skilled migrants (Epstein, 2002; Bauer et al., 2007).

[26]For instance, France is a destination preferred by students who are largely legal migrants.

[27]The tightening of French immigration policies these last years has increased the interest for other destinations such as Spain or Italy (Fall, 2003). If we compare and replace in the context of 2006 and 2007 Spain, for instance, sorted out illegal migrants five times between 1985 and 2004 with the increase in labor demand due to the economic boom. The legitimization of illegal migrants could therefore generate additional flows and be a supplementary motivation for people remaining in the country of origin and desiring to migrate. Of course, since the beginning of the economic crisis of 2008 and even before then the situation was different in Spain and Italy.

or motivations of people are formed regarding the decision to migrate illegally . We first analyze the relation between the socio-demographic and economic characteristics of potential migrants and their propensity to consider migrating illegally. We later examine the channels of how the price of migration, the expected foreign wage, the potential migrant networks and tight immigration policies affect illegal migration considerations.

Our results show that potential illegal migrants are willing to accept a substantial risk of death (25% at the median) and tend to be young, single and with a low level of education. The price of illegal migration is negatively correlated with the illegal migration intention which suggests that the poorest are not able to migrate illegally. Biased expectations towards the popular destination countries increase the likelihood to migrate illegally. Consequently, people may base a risky decision on wrong information. There is a positive relationship between migrant networks and illegal migration intentions which may be due to the fact that relatives who have already migrated give a true or false picture of their living conditions that can increase the desire of potential illegal migrants. We also find that contrary to the initial objectives a tightening of immigration policies for entering host countries deter more legal than illegal potential migrants. Finally, some particular destinations such as Spain or Italy are more attractive and more correlated with the likelihood of migrating illegally from Senegal than is France, the U.S. or United Kingdom. Historical links, cultural proximity and language matter less in the choice of the destination country.

As we report in this chapter, illegal migration starts first in thoughts. It is the result of the belief that success is only possible abroad. In order to reduce illegal migration flows and to develop more efficient immigration policies in Europe, solutions have to be entered

in a long-term perspective by integrating both recipient and sending countries and above all by being more focused on the formation of intentions that are the first step of an illegal migration project. In the Senegalese case, a radical change is necessary in the way of thinking and viewing migration as the unique way to succeed. In order to accomplish these goals it would be very relevant to improve the absolute income but it would be not sufficient if it does not reduce frustration and feelings of injustice. Some awareness campaign on the real living conditions of many migrants in the host country could be useful to relativize the situation of non migrants and allow them to take decisions using correct information. It would be also helpful to promote better governance and more trust in the ability of the leaders of the country of origin to create good conditions of success.

Table 2.1. Summary statistics

Variables	Legal migration		Illegal migration		Total	
	Mean	SD	Mean	SD	Mean	SD
Expected foreign wage	1 850 505	7 008 376	1 141 931	1 158 843	1 567 466	5 486 186
Expected foreign wage per capita	1 089 245	6 829 681	600 252.9	1 021 903	893 918	5 332 343
Wage	77 684.68	66 006.94	73 604.35	62 840.70	76 054.93	64 698.93
Wage per capita	20 678.40	15 647.79	22 690.14	18 800.45	21 481.92	16 979.35
Tightening of immigration policies	0.62	0.49	0.79	0.41	0.68	0.47
Relatives	0.66	0.48	0.88	0.33	0.74	0.44
Spain	0.18	0.39	0.41	0.49	0.27	0.44
Italy	0.15	0.36	0.26	0.44	0.19	0.39
US	0.31	0.46	0.16	0.37	0.25	0.43
France	0.15	0.36	0.03	0.16	0.10	0.31
United Kingdom	0.06	0.24	0.03	0.18	0.05	0.22
Canada	0.04	0.20	0.01	0.12	0.03	0.17
Anywhere	0.11	0.31	0.10	0.31	0.11	0.31
Visa price					829 785.10	485 625.33
Canoe price					419 089.91	43 049.96
Embassy price					3 071 603	935 445.5
Migration prices					2 220 254	1 756 592
Male	0.88	0.33	0.88	0.32	0.88	0.33
Age	26.95	08.01	24.45	5.36	25.96	7.18
Married	0.32	0.47	0.17	0.37	0.26	0.44
Child is male	0.88	0.33	0.78	0.42	0.84	0.37
Child is female	0.89	0.31	0.78	0.42	0.85	0.36
Adult is male	0.79	0.41	0.70	0.46	0.75	0.43
Adult is female	0.84	0.37	0.84	0.37	0.84	0.37

Table 2.1: Summary statistics (continued)

Variables	Legal migration		Illegal migration		Total	
	Mean	SD	Mean	SD	Mean	SD
Education level						
Low education level	0.33	0.47	0.55	0.50	0.42	0.49
Secondary level	0.27	0.45	0.26	0.44	0.27	0.44
University level	0.24	0.43	0.05	0.22	0.16	0.37
Koranic school	0.16	0.37	0.14	0.35	0.15	0.36
Home owner	0.57	0.50	0.54	0.50	0.56	0.50
Mouride	0.39	0.49	0.54	0.50	0.45	0.50
Ethnic dummies						
Wolof	0.36	0.48	0.30	0.46	0.34	0.47
Lebou	0.16	0.37	0.23	0.42	0.19	0.39
Hal Pular	0.14	0.34	0.08	0.27	0.11	0.32
Serere	0.22	0.41	0.24	0.43	0.23	0.42
Diola	0.05	0.23	0.06	0.23	0.05	0.23
Manjack	0.01	0.09	0.01	0.12	0.01	0.10
Bambara, Mandingue, Sub-region	0.06	0.24	0.08	0.28	0.07	0.26
Region dummies						
Campus	0.17	0.38	0.02	0.14	0.11	0.32
Fass, Medina and Geule tapée	0.11	0.32	0.10	0.31	0.11	0.31
Guédiawaye	0.34	0.48	0.39	0.49	0.36	0.48
Sandaga	0.10	0.30	0.16	0.37	0.12	0.33
Kayar, Thiaroye, Yarakh and Yoff	0.27	0.45	0.33	0.47	0.30	0.46
Observations	222		145		367	

Note: Amounts are presented in Fcfa and 1 Euro=656.56 Fcfa.

Table 2.2. Average migration prices according to the destination countries

	Visa method 1	Visa method 2	Canoe method	Embassy method
Spain	1 100 000	450 552	391 981	2 153 846
US	910 000	828 567	430 000	4 041 667
Italy	250 000	537 875	390 476	2 346 154
France	237 500	495 855	unknown	2 952 381
United Kingdom	unknown	543 390	unknown	3 700 000
Canada	200 000	873 377	600 000	1 850 000
Other	1 750 000		462 500	4 585 715

Notes: Prices are presented in Fcfa. 1 Euro=655.957 Fcfa. Visa method 1 means that the legal migration prices are given by respondents. Visa method 2 represents the real prices of legal migration. For the canoe method for the U.S., we only see one press report that reported a case of boat-people trying to reach this country. And for the case of Canada, we just have two respondents that gave us the prices for this destination and this kind of migration. Consequently, it was difficult to check the "canoe method" prices for this destination because we had fewer respondents and the use of boats or roads to Canada is perhaps not impossible but unlikely. The Visa method 1 price is unknown for the United Kingdom and the Canoe method price is unknown both for France and the United Kingdom. The reason is that we did not find any respondent that was able to give us these prices. For all the other prices we were able to check their reliability.

Table 2.3. Individual characteristics and willingness to migrate illegally

	Probit Model			
	Marginal effects			
	(1)	(2)	(3)	(4)
Log wage per capita		0.002		0.010
		(0.05)		(0.26)
Education level				
Secondary level			-0.129**	-0.124*
			(2.09)	(1.91)
University level			-0.281***	-0.332***
			(3.77)	(4.94)
Koranic school			-0.120	-0.106
			(1.62)	(1.37)
Male	0.083	0.108	0.121	0.137
	(0.98)	(1.26)	(1.47)	(1.63)
Age	-0.012**	-0.013**	-0.011**	-0.012**
	(2.27)	(2.41)	(2.05)	(2.11)
Married	-0.252***	-0.246***	-0.259***	-0.257***
	(4.05)	(3.75)	(4.20)	(3.95)
Child is male	-0.083	-0.106	-0.091	-0.116
	(0.95)	(1.15)	(1.06)	(1.29)
Child is female	-0.132	-0.137	-0.110	-0.117
	(1.41)	(1.40)	(1.16)	(1.17)
Adult is male	-0.084	-0.065	-0.079	-0.058
	(1.16)	(0.89)	(1.06)	(0.78)
Adult is female	0.100	0.103	0.107	0.112
	(1.28)	(1.25)	(1.38)	(1.39)
Home owner	-0.108*	-0.088	-0.098*	-0.075
	(1.90)	(1.50)	(1.66)	(1.24)
Mouride	0.136**	0.136**	0.125**	0.125**
	(2.33)	(2.22)	(2.11)	(2.02)
Observations	367	343	367	343

Notes: The reference category of the variable education level is low education level. Ethnic and Region dummies are included in all estimates. Robust z-statistics in parenthesis:* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 2.4. Migration costs and willingness to migrate illegally

	Probit model				
	Marginal effects				
	(1)	(2)	(3)	(4)	(5)
Log visa price	0.045			0.035	
	(1.07)			(0.64)	
Log canoe price		-1.011**		-0.602	
		(2.45)		(1.54)	
Log embassy price			-0.319***	-0.262**	
			(3.15)	(2.03)	
Log migration prices					-0.325***
Socio-demographic variables	Yes	Yes	Yes	Yes	Yes
Ethnic dummies	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes
Observations	327	290	243	290	343

Notes: Robust z-statistics in parenthesis:* significant at 10%; ** significant at 5%; *** significant at 1%. Tables showing results with Socio-demographic variables, Ethnic and Region dummies are available upon request.

Table 2.5. Expectations, relatives, migration policies and willingness to migrate illegally

	Probit Model			
	Marginal effects			
	(1)	(2)	(3)	(4)
Log expected foreign wage	0.065**			0.065*
	(1.97)			(1.89)
Relatives		0.140*		0.145*
		(1.79)		(1.79)
Tightening of immigration policies			0.207***	0.202***
			(3.31)	(3.16)
Log migration prices	-0.342***	-0.318***	-0.336***	-0.347***
	(8.77)	(8.89)	(9.10)	(8.87)
Socio-demographic variables	Yes	Yes	Yes	Yes
Ethnic dummies	Yes	Yes	Yes	Yes
Regions dummies	Yes	Yes	Yes	Yes
Observations	339	343	343	339

Notes: Robust z-statistics in parenthesis:* significant at 10%; ** significant at 5%; *** significant at 1%. Tables showing results with Socio-demographic variables, Ethnic and Region dummies are available upon request.

Table 2.6. Destinations and willingness to migrate illegally

	Probit model						
	Marginal effects						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Spain	0.210***						
	(3.10)						
Italy		0.180**					
		(2.32)					
US			-0.149**				
			(2.36)				
France				-0.280***			
				(3.99)			
United Kingdom					-0.267***		
					(3.20)		
Canada						0.008	
						(0.19)	
Other							0.047
Socio-demographic variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ethnic dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	343	343	343	343	343	343	343

Notes: Robust z-statistics in parenthesis:* significant at 10%; ** significant at 5%; *** significant at 1%. Tables showing results with Socio-demographic variables, Ethnic and Region dummies are available upon request.

Figure 2.1. Probabilities of death reported by individuals willing to risk their life

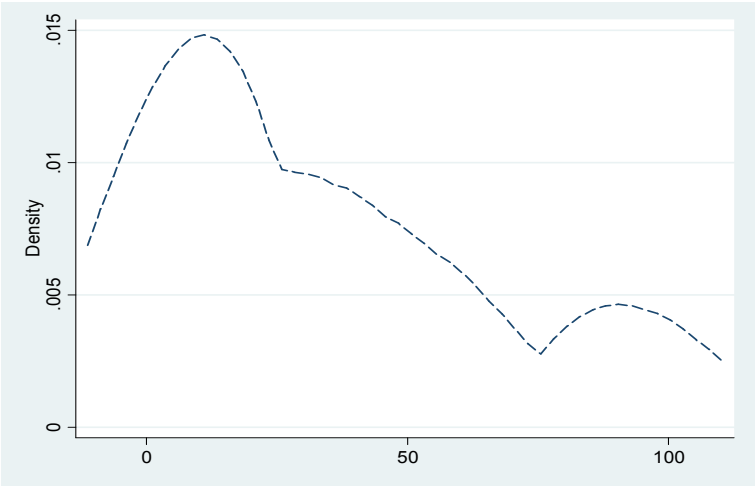


Figure 2.2. Income expectations and perceptions of potential illegal migrants

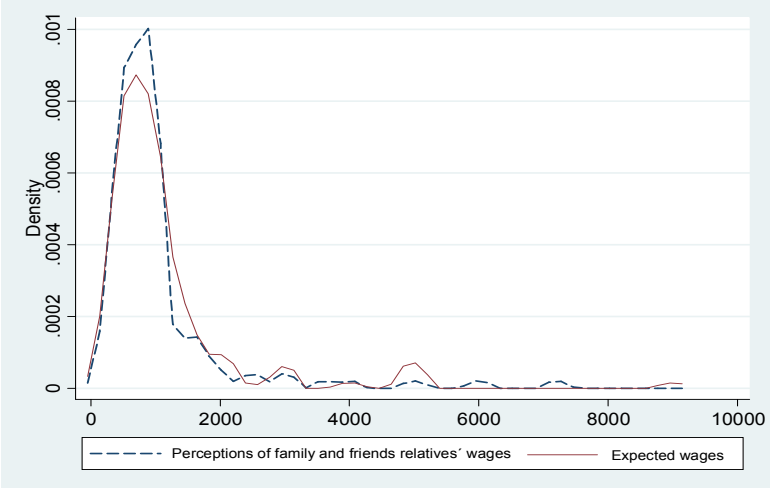


Figure 2.3. Income expectations and perceptions of potential legal migrants

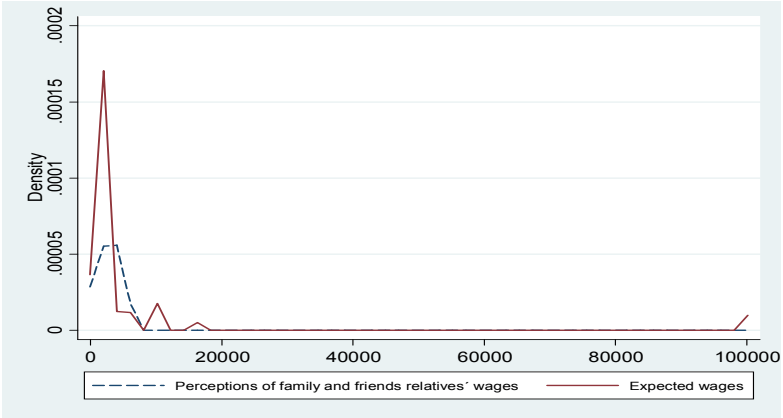
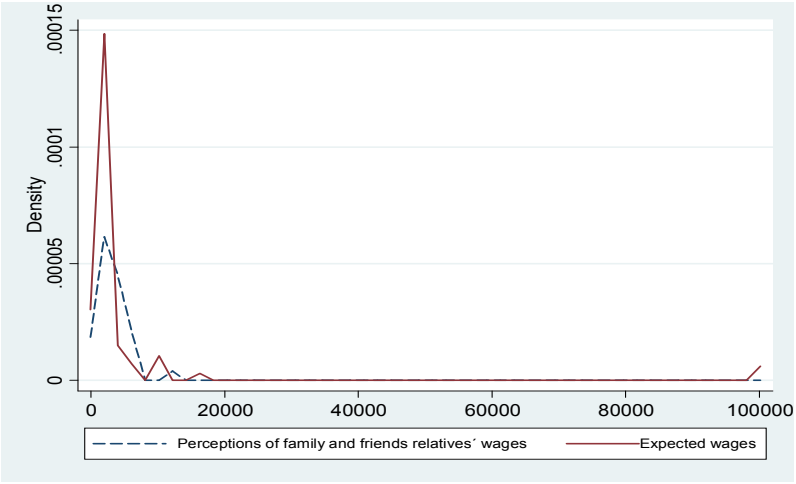


Figure 2.4. Income expectations and perceptions of potential migrants



Appendix

A.1 Questionnaire of the Survey made in Senegal

Area.....

(1) Gender of the interviewee: (1) Male (2) Female

(2) Age of the interviewee ...

(3) Marital status

(1) Single (2) Married (3) Widowed (4) Divorced (5) Other (specify).....

(4) Ethnic group

(1) Wolof (2) Lébou (3) Hal Pular (4) Sérère (5) Diola (6) Manjaks (7) Other (specify) ...

(5) Religious brotherhood

(1) Mouride (2) Tidjiane (3) Layenne (4) Niassène (5) Catholic (6) Protestant (7) Other (specify) ...

(6) Education level

(1) None (2) Primary (3) Secondary (4) University or Professional education (5) Koranic school (6) Literacy in a national language (7) Other (specify)...

(7) Do you have an activity? (1) Yes (2) No

7.1 If yes, which one?

(1) Craftsman (2) Fishman (3) Labourer (4) Hawker (5) Trader (6) Employee (7) Student (8) Retail trade (9) Other (specify) ...

(8) Do you have any dependents? (1) Yes (2) No

8.1 If yes, please help us to fill this table:

	Men	Women	Total
Children (<15 years old)			
Adults (>15 years old)			
Total			

(9) How much do you earn each month?.....

(10) What is your home occupation status?

(1) Room (2) Apartment (3) Familial house (4) Rough House or slum (6) Other (specify) .....

(11) Home occupation status of you and your family?

(1) Home owner (2) Tenant (3) Other (specify) ...

11.1 If you are tenant, what is the monthly amount of rent (in FCFA) ?.....

(12) How much did you spend in the last week?

Food	...	Transport	...
Health	...	Other	...
Education	...	Total	...

(13) Are you willing to migrate? (1) Yes (2) No

If no, acknowledge and stop the survey

13.1 If yes, why? (many possible answers)

(1) Poverty (2) Unemployment (3) Living conditions (4) Feeling of unfairness (5) To be useful to my family (6) To do the same thing as others (7) Other (specify)...

(14) If this reason disappeared, would you still like to migrate?

(1) Yes (2) No

(15) If you are not able to migrate legally, are you willing to migrate illegally?

(1) Yes (2) No

(16) Will you forego the idea of migrating if immigration policies to enter the host countries were tightened?

(1) Yes (2) No

(17) Have you ever tried to migrate? (1) Yes (2) No

If no, go to question 20

17.1 If yes, how many attempts have you ever made? . . .

17.2 How much have you ever spent for these attempts? . . .

(18) Where do you find the resources to migrate? (Many possible answers)

(1) Temporary job (2) Savings (3) Gifts (4) Borrowing from relatives (5) Other (specify).....

(19) Why don't you try to invest or start a professional activity with the amount collected? (Many possible answers)

(1) Lack of qualification (2) No help or support (3) Too much corruption (4) Anyway, it will not work (5) Other (specify).....

(20) To which country would you like to migrate?

(1) Spain (2) United States (3) Italy (4) France (5) United Kingdom (6) Canada (7) Other (specify)...

20.1 Why? (Many possible answers)

(1) More flexible migration policies (2) Earn money (3) Huge Senegalese diaspora (4) Family (5) Friends (6) Extended Relatives

(7) Easier integration (language, culture...) (8) Easier access to jobs (9) Access to education and health care

(10) Discovering anything else (11) Other (specify)...

20.2 What is the price for this destination (specify the type of prices)? . . .

(21) How much are you expecting to earn each month in the destination country?. . .

If you are not willing to migrate illegally, go to question 27

(22) How much would you be willing to pay to a smuggler if you were 100% sure of a successful migration?...

(23) If you had 75% of probability of success, would you be willing to migrate? (1) Yes (2) No

23.1 If yes, how much are you willing to pay to a smuggler? . . . . . .

(24) If you have 50% of probability of success, are you willing to migrate? (1) Yes (2) No

24.1 If yes, how much are you willing to pay to a smuggler? . . . . .

(25) If you had 25% of probability of success, would you be willing to migrate? (1) Yes (2) No

25.1 If yes, how much are you willing to pay to a smuggler? . . .

(26) If you had 5% of probability of success, would you be willing to migrate? (1) Yes (2) No

26.1 If yes, how much are you willing to pay to a smuggler? . . . . . .

(27) How much would you accept to give up on migration and stay in Senegal?...

(28) Are you willing to risk your life by migrating? (1) Yes (2) No

28.1 If yes, what are your chances of dying? . . . . . .

(29) Do you have family or friends' relatives who tried and succeeded to migrate? (1) Yes (2) No

29.1 If yes, how much do you think that they earn in the destination country? . . .

29.2 If no, having some family or friends' relatives that do not succeed in migrating, was it discouraging for you? (1) Yes (2) No

A.2 Definition of variables

Variables	Definition
Expected foreign wage per capita	Expected wage in the destination country reported by potential migrant divided by 1+ the number of dependents
Wage	Measured by the total of monthly expenditures per capita (total of monthly expenditures divided by 1+ the number of dependents) considered as the proxy of the potential migrant's wage
Tightening of immigration policies	Dummy equal to 1 if the potential migrant does not give up on migration if the immigration policies in the host countries were tight.
Relatives	Dummy variable taking the value 1 if the individual has members of his family, close friends or relatives who have migrated
Destinations	(Dummies variables) The destination country where potential migrant wants to go
Spain	Dummy equal to 1 if the individual wants to go to Spain
Italy	Dummy equal to 1 if the individual wants to go to Italy
France	Dummy equal to 1 if the individual wants to go to France
US	Dummy equal to 1 if the individual wants to go to United States
United Kingdom	Dummy equal to 1 if the individual wants to go to United Kingdom
Canada	Dummy equal to 1 if the individual wants to go to Canada
Other	Dummy equal to 1 if the individual wants to go to anywhere: The potential migrant wants to go to Portugal or Switzerland or in the majority of cases, anywhere i.e the destination has no importance, he just wants to migrate
Visa price	Average price for each destination for the Visa Method (legal migration method)
Canoe price	Average price for each destination for the Canoe Method (illegal migration method)
Embassy price	Average price for each destination for Embassy Method (illegal migration method)
Migration prices	Prices for the different destinations and the different methods of migration without distinction between the methods of migration
Male	Dummy variable taking the value 1 if the individual is male
Age	Age declared by the individual
Married	A dummy equal to 1 if the individual is married
Child is male	Dummy equal to 1 if the individual has a male dependent child
Child is female	Dummy equal to 1 if the individual has a female dependent child
Adult is male	Dummy equal to 1 if the individual has a male dependent adult
Adult is female	Dummy equal to 1 if the individual has a female dependent adult

Definition of variables (Continued)

Variables	Definition
Education level	Dummies variables
Low education level	The reference group : in addition to those who have a primary level, it also includes people who received literacy lectures and those who received no education
Secondary level	The individual has a secondary level
University level	The individual has a university level or a professional education
Koranic school	The individual went to Koranic school
Home owner	Dummy equal to 1 if the individual lives in his own house or in a house belonging to his family
Mouride	Religious dummy equal to 1 if the individual belongs to the Mouride's brotherhood. The others brotherhoods are Tidiane, Layenne, Niassène, (which are all Muslims), Catholic, Protestant, Muslim who does not belong to any particular group, animist or without religion.
Ethnic dummies	For each ethnic group represented: Wolof, Lebou, Hal Pular, Serere, Diola, Manjack, Other (Bambara, Mandingue or Come from the sub-region (Guinea, Mauritania, Ivory Coast)
Region dummies	For each area of Dakar represented: University Campus and its surroundings; Fass, Medina and Gueule-Tapée; Guédiawaye; Sandaga; Kayar, Thiaroye, Yarakh and Yoff.

References

[1] Adepoju, A. and Afrikainstitutet, N. (2008): "Migration in Sub-Saharan Africa", Nordiska Afrikainstitutet.

[2] Ajzen, I. (1991): "The theory of planned behavior", *Organizational Behavior and Human Decision Processes,* 50(2), 179-211.

[3] Ajzen, I. (1988): "Attitudes, Personality and Behavior", Open University Press, Milton Keynes.

[4] Ajzen, I. and Fishbein, M. (1980): "Understanding attitudes and predicting social behaviour", Prentice-Hall, Englewood Cliffs, New Jersey.

[5] Angelucci, M. (2012): "US Border Enforcement and the Net Flow of Mexican Illegal Migration", *Economic Development and Cultural Change,* 60(2), 311 - 357.

[6] Azam, J.-P. and Gubert, F. (2005): "Those in Kayes. The Impact of Remittances on Their Recipients in Africa", *Revue économique*, 56(6), 1331-1358.

[7] Banerjee, A. V. (1992): "A Simple Model of Herd Behavior", *The Quarterly Journal of Economics*, 107(3),797-817.

[8] Bauer, T.; Epstein, G. and Gang, I. (2005): "Enclaves, language, and the location choice of migrants", *Journal of Population Economics*, 18, 649-662.

[9] Bauer, T.; Epstein, G. and Gang, I. (2007): "Herd Effects or Migration Networks? The Location Choice of Mexican Immigrants in the U.S", *Research in Labor Economics*, 26, 199-229.

[10] Beauchemin, C. and Schoumaker, B. (2009): "Are Migrant Associations Actors in Local Development? A National Event-History Analysis in Rural Burkina Faso", *World Development*, 37(12), 1897-1913.

[11] Beine, M.; Docquier, F. and Çaglar Özden (2011): "Diasporas", *Journal of Development Economics*, 95, 30-41.

[12] Bertoli, S.; Moraga, J. F.-H. and Ortega, F. (2011): "Immigration Policies and the Ecuadorian Exodus", *World Bank Economic Review*, 25(1), 57-76.

[13] Bertrand, M. and Mullainathan, S. (2001): "Do People Mean What They Say? Implications for Subjective Survey Data", *American Economic Review*, 91(2), 67-72.

[14] Borjas, G. J. (1987): "Self-Selection and the Earnings of Immigrants", *The American Economic Review*, 77(4), 531-553.

[15] Borodak, D. and Miniscloux, A. T. (2009): "Should we stay or should we go? Irregular Migration and duration of stay: the case of Moldovan Migrants", Technical report, CERDI.

[16] Burda, M. C. (1993), "The determinants of East-West German migration: Some first results", *European Economic Review*, 37(2-3), 452-461.

[17] Carrington, W. J.; Detragiache, E. and Vishwanath, T. (1996): "Migration with Endogenous Moving Costs", *The American Economic Review*, 86(4), pp. 909-930.

[18] Chiquiar, D. and Hanson, G. H. (2005): "International Migration, Self-Selection, and the Distribution of Wages: Evidence from Mexico and the United States", *Journal of Political Economy*, 113(2), 239-281.

[19] Chiswick, B. R. (1999): "Are Immigrants Favorably Self-Selected?", *The American Economic Review,* 89(2), 181-185

[20] Chiswick, B.; Lee, Y. and Miller, P. (2005): "Family matters: the role of the family in immigrants' destination language acquisition", *Journal of Population Economics*, 18(4), 631-647.

[21] Chiuri, M.; De Arcangelis, G.; D'Uggento, A. and Ferri, G. (2007): "Features and Expectations of Illegal Immigrants: Results of a Field Survey", Technical report, ChilD-Centre for Household, Income, Labour and Demographic Economics.

[22] Dalen, H. V.; Groenewold, G. and Schoorl, J. (2005a): "Out of Africa: what drives the pressure to emigrate?", *Journal of Population Economics*, 18, 741-778.

[23] Dalen, H. V.; Groenewold, G. and Fokkema, T. (2005b): "The effect of remittances on emigration intentions in Egypt, Morroco and Turkey", *Population Studies*, 59, 3, 375-392.

[24] Dalen, H. V. and Henkens, K. (2008):"Emigration Intentions: Mere Words or True Plans? Explaining International Migration Intentions and Behavior", Technical report, Tilburg University, Center for Economic Research.

[25] De Haas, H. (2006): "Trans-Saharan Migration to North Africa and the EU: Historical Roots and Current Trends", University of Oxford.

[26] Diatta, M. A. and Mbow, N. (1999): "Releasing the Development Potential of Return Migration: The Case of Senegal", *International Migration*, 37(1), 243-266.

[27] Dohmen, T.; Falk, A.; Huffman, D.; Sunde, U.; Schupp, J. and Wagner, G. G. (2005): "Individual Risk Attitudes: New Evidence from a Large, Representative, Experimentally-Validated Survey", Technical report, Institute for the Study of Labor (IZA).

[28] Dolfin, S. and Genicot, G. (2010): "What Do Networks Do? The Role of Networks on Migration and "coyote" use", *Review of Development Economics*, 14(2), 343-359.

[29] Epstein, G. S. (2002): "Informational Cascades and Decision to Migrate", Technical report, C.E.P.R. Discussion Papers.

[30] Epstein, G. S. and Gang, I. N. (2006): "The Influence of Others on Migration Plans", *Review of Development Economics,* 10(4), 652-665.

[31] Fafchamps, M. and Shilpi, F. (2013),"Determinants of the Choice of Migration Destination", *Oxford Bulletin of Economics and Statistic*s, Forthcoming.

[32] Fall, A. S. (1998): "Migrants' long-distance relationships and social networks in Dakar", *Environment and Urbanization,* 10, 135-146.

[33] Fall, P. D. (2007): "Ndaraw, Sekka, Sidi Bara, Yéri et les autres. Enquêtes sur le mbëkk dans la banlieue dakaroise", Technical report, Communication au Séminaire de

la Commission scientifique de l'IFAN Ch. A. Diop sur Barça ou Barsaq : quelles lectures des sciences sociales sur l'actualité des migrations internationales?.

[34] Fall, P. D. (2003): "Migration internationale et droits des travailleurs au Sénégal", Technical report, UNESCO.

[35] Fouarge, D. and Ester, P. (2007): "Factors Determining International and Regional Migration in Europe European Foundation for the Improvement of Living and Working Conditions", Technical report, European Foundation for the Improvement of Living and Working Conditions, Dublin.

[36] Friebel, G.; Gallego, J. M. and Mendola, M. (2011): "Xenophobic Attacks, Migration Intentions and Networks: Evidence from the South of Africa", Technical report, Institute for the Study of Labor (IZA).

[37] Friebel, G. and Guriev, S. (2006): "Smuggling Humans: A Theory of Debt-financed Migration", *Journal of the European Economic Association,* 4(6), 1085-1111.

[38] Gathmann, C. (2008): "Effects of enforcement on illegal markets: Evidence from migrant smuggling along the southwestern borde", *Journal of Public Economics*, 92(10-11), 1926-1941.

[39] Hanson, G. H. (2006): "Illegal Migration from Mexico to the United States", *Journal of Economic Literature*, 44(4), 869-924.

[40] Hanson, G. H. and Spilimbergo, A. (1999): "Illegal Immigration, Border Enforcement, and Relative Wages: Evidence from Apprehensions at the U.S.-Mexico Border", *American Economic Review*, 89(5), 1337-1357.

[41] IOM (2010): "The Future of Migration: Buildings Capacities for Change",World Development Report 2010, International Organization for Migration.

[42] Jaeger, David, A. (2000): "Local labor markets, admission categories, and immigrant location choice", Unpublished paper, College of William and Mary.

[43] Jong, G. F. D. (2000): "Expectations, Gender, and Norms in Migration Decision-Making", *Population Studies*, 54(3), 307-319.

[44] Kane, A. (2002): "Senegal's Village Diaspora and the People Left Ahead", in The Transnational Family: New European Frontiers and Global Networks Bryceson, Deborah and Vuorela, Ulla, eds., New York: Berg.

[45] Knight, J. and Gunatilaka, R. (2010): "Great Expectations? The Subjective Well-being of Rural-Urban Migrants in China", *World Development*, 38(1), 113-124.

[46] Konseiga, A. (2007): "Household Migration Decisions as Survival Strategy: The Case of Burkina Faso", *Journal of African Economies*, 16(2), 198-233.

[47] Liebig, T. and Sousa-Poza, A. (2004): "Migration, Self-Selection and Income Inequality: An International Analysis", *Kyklos,* 57(1), 125-146.

[48] Manchuelle, F.(1997): "Willing migrants: Soninke labor diasporas, 1848-1960", Athens : Ohio University Press; London : J. Currey Publishers.

[49] Manski, C. F. (1990): "The Use of Intentions Data to Predict Behavior: A Best-Case Analysis", *Journal of the American Statistical Association*, 85(412), 934-940.

[50] Massey, D. S. and Espinosa, K. E. (1997): "What's Driving Mexico-U.S. Migration? A Theoretical, Empirical, and Policy Analysis", *American Journal of Sociology*, 102(4), 939-99.

[51] Mayda, A. (2010): "International migration: a panel data analysis of the determinants of bilateral flows", *Journal of Population Economics*, 23(4), 1249-1274.

[52] Mbow, P. (2008): "L'immigration clandestine: Le profil des candidats", Technical report, Caritas Forum International de Dakar Migrations, Politiques et Droits de l'Homme.

[53] Mckenzie, D. and Rapoport, H. (2007): "Network effects and the dynamics of migration and inequality: Theory and evidence from Mexico", *Journal of Development Economics*, 84(1), 1-24.

[54] McKenzie, D.; Stillman, S. and Gibson, J. (2012): "A land of milk and honey with streets paved with gold: Do emigrants have over-optimistic expectations about incomes abroad?", *Journal of Development Economics* (2012), doi:10.1016/j.jdeveco.2012.01.001.

[55] Melly, C. M. (2011): "Titanic tales of missing men: Reconfigurations of national identity and gendered presence in Dakar, Senegal", *American Ethnologist*, 38(2), 361-376.

[56] Munshi, K. (2003): "Networks In The Modern Economy: Mexican Migrants In The U.S. Labor Market", *The Quarterly Journal of Economics*, 118(2), 549-599.

[57] Orrenius, P. (2004): "The Effect of U.S. Border Enforcement on the Crossing Behavior of Mexican Migrants" In Crossing the Border: Research from the Mexican Migration Project, Jorge Durand and Douglas S. Massey, eds., Russell Sage Foundation.

[58] Orrenius, P. M. and Zavodny, M. (2005): "Self-selection among undocumented immigrants from Mexico", *Journal of Development Economics*, 78(1), 215-240.

[59] Ortega, F. and Peri, G. (2012): "The Role of Income and Immigration Policies in Attracting International Migrants", Technical report, Institute for the Study of Labor (IZA).

[60] Pedersen, P. J.; Pytlikova, M. and Smith, N. (2008): "Selection and network effects– Migration flows into OECD countries 1990-2000", *European Economic Review*, 52(7), 1160-1186.

[61] Pena, A. A. (2009): "Locational Choices of the Legal and Illegal: The Case of Mexican Agricultural Workers in the U.S.", *International Migration Review*, 43(4), 850–880.

[62] Ratha, D.; Mohapatra, S.; Ozden, C.; Plaza, S.; Shaw, W. and Shimeles, A. (2011): Leveraging Migration for Africa: Remittances, Skills, and Investments, World Bank Publications.

[63] Riccio, B. (2005): "Talking About Migration: Some Ethnographic Notes on the Ambivalent Representation of Migrants in Contemporary Senegal", Stichproben. Wiener Zeitschrift für kritische Afrikastudien, 5 (8), 99-118.

[64] Riccio, B. (2008): "West African Transnationalisms Compared: Ghanaians and Senegalese in Italy", *Journal of Ethnic and Migration Studies,* 34(2), 217–234.

[65] Runciman, W. G. (1966): "Relative deprivation and social justice: a study of attitudes to social inequality in twentieth century Britain", Gregg Revivals.

[66] Sabates-Wheeler, R.; Taylor, L. and Natali, C. (2009): "Great Expectations and Reality Checks: The Role of Information in Mediating Migrants' Experience of Return", *The European Journal of Development Research*, 21(5), 752-771.

[67] Singer, A. and Massey, D. S. (1998): "The Social Process of Undocumented Border Crossing among Mexican Migrants", *International Migration Review*, 32(3),561-592.

[68] Stark, O. (2006): "Inequality and migration: A behavioral link", *Economics Letters*, 91(1), 146-152.

[69] Stark, O.; Micevska, M. and Mycielski, J. (2009): "Relative poverty as a determinant of migration: Evidence from Poland", Economics Letters, 103(3), 119-122.

[70] Stark, O. and Taylor, J. (1989): "Relative deprivation and international migration oded stark", *Demography*, 26(1), 1-14.

[71] Winters, P.; de Janvry, A. and Sadoulet, E. (2001): "Family and Community Networks in Mexico-U.S. Migration", *Journal of Human Resources*, 36(1), 159-184.

[72] Zaiceva, A. and Zimmermann, K. F. (2008): "Scale, diversity, and determinants of labour migration in Europe", *Oxford Review of Economic Policy,* 24(3), 428-452.

Chapter 3

Braving the waves: the role of time and risk preferences in illegal migration from Senegal

3.1. Introduction

Illegal migration from less developed countries to rich countries is a very controversial topic and this issue will become more and more important as the 21st century progresses. Images of "fortress Europe" with hordes of impoverished people coming from Africa and knocking at the gates are the basis upon which many right-wing European politicians base their legitimacy. Despite the scope of illegal migration between Africa and Europe,

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the determinants of this phenomenon have not been studied to any great extent. The major part of the literature is related to illegal migration between Mexico and the U.S.. These studies show that illegal migrants flows are determined by economic conditions and more specifically by large wage differentials between these two countries (Hanson, 2006; Orrenius and Zavodny, 2005; Hanson and Spilimbergo, 1999), the presence of migrant networks (Massey and Espinoza, 1997; Singer and Massey, 1998; Dolfin and Genicot, 2010) or strict deportation policies (Friebel and Guriev, 2006).

The aim of this chapter is to go beyond traditional determinants of migration such as expectations or networks and study how risk and time preferences influence illegal migration intentions and the willingness to pay (WTP) a smuggler in an African context. In order to examine the role of preferences on illegal migration intentions, we conducted a tailor-made survey between November 2006 and April 2007 on 400 individuals in Dakar. We chose Senegal for this study because this country has been severely affected by illegal migration. As far as we know, no survey comparable has been realized making our study unique. During the survey we collected information about the socio-demographic characteristics of people, their intentions and attitudes about illegal migration and their WTP a smuggler in order to attempt illegal migration.

Since we are interested in the role of preferences in illegal migration intentions and more specifically in the WTP a smuggler with a probability one of success, we draw on literature of the determinants of the WTP and of the role of risk and time preferences on the agents' decision-making and on the willingness to pay. The WTP concept is generally used in contingent valuation methods in order to evaluate the monetary value of a non-market good. These concepts have been largely studied in many areas such

as environment (see for instance Hanemann, 1994; Whittington et al., 1990; Verbic and Slabe-Erker, 2009), health economics (see for instance Gustafsson-Wright et al., 2009; Protière et al., 2004; N'guessan, 2008; Dror et al., 2007) or infrastructures (Torero et al., 2003). The determinants of the willingness to pay have also been studied in the field of migration. For instance, Sengupta and Hedge (2005) study the determinants of the willingness to pay among undocumented agricultural workers from Mexico for getting legal visas in rural Southern California. According to these authors, the willingness to pay of undocumented workers measures the perceived benefit of having a legal status and the implicit cost of being undocumented. They find that this WTP is determined by the perception that the legal status is both associated with a higher wage and a reduction of the unemployment period at the beginning of the migration to the U.S.. In the case of the role of individual preferences on the WTP a smuggler, it is interesting to look at how risk and time preferences affect agents' decision-making in general and migration intentions in particular. From the 1995 Bank of Italy Survey of Household Income and Wealth (SHIM), Paiella and Guiso(2004) use the WTP for a hypothetical risky asset to measure the degree of risk aversion of households. They find that risk aversion plays an important role in household decisions related to their choice of occupation, portfolio selection, investment in education, job moving decisions and exposure to chronic diseases. In the case of migration, Daveri and Faini (1999) use aggregate panel data from Southern Italy and find that risk-aversion is a strong determinant of internal and international migration. Heitmueller (2005) argues that being risk-averse decreases the likelihood to migrate relative to being risk neutral. Moreover, risk-averse people are more likely to go to countries with high unemployment benefits because they decrease the volatility

of expected payoffs of migration whereas risk-loving people will choose countries with a high degree of income volatility that increases their utility. These results are confirmed by Nowotny (2010) who finds that being risk averse decreases the willingness to migrate and to commute whereas a higher discount rate is associated with a higher intention to migrate.

In the case of our study, we interpret the willingness to pay a smuggler with a probability one of success as the perception of the payoff of a successful illegal migration. The payoff here is defined as safe arrival in the destination country without being apprehended. During the survey we ask to people direct questions to elicit information about their willingness to pay a smuggler, their degree of aversion to risk and their subjective rate of time preference. Our approach is similar to Barsky et al., (1997). From an experimental approach with participants in the Health and Retirement Study, these authors ask direct questions that involve choice in hypothetical situations. Their measure of risk aversion is obtained with answers about the willingness of people to gamble on life-time income and their measure of intertemporal substitution, and time preferences are obtained by asking people to choose consumption profiles implicitly associated with different rates of return. In this study, we first use a theoretical model to study how preferences affect the illegal migration intention and the willingness to pay a smuggler with a probability one of success. Then, we define theoretically two expressions of time and risk preferences through the individual intertemporal discount rate and the individual's coefficient of absolute risk aversion. We later compute for each individual a mean value of the discount rate and of the coefficient of absolute risk-aversion with an associated standard deviation. Finally, we use a Heckman procedure to empirically test our theoretical predictions because the

willingness to pay a smuggler with a probability one of success is only observed for the sample of potential illegal migrants. However, we have to specify that the individual preferences variables are also only available for the potential illegal migrants. Therefore, we are not able to test the theoretical predictions of the effect of these variables on the illegal migration intention but only on the willingness to pay a smuggler.

Our results can be summarized as follows: first, the likelihood that an individual chooses illegal over legal migration is an increasing function of the intertemporal discount rate, an ambiguous function of risk-aversion, an increasing function of the expected foreign wage and a decreasing function of the price of illegal migration. Second, the price that an individual is willing to pay a smuggler for an illegal migration attempt with a probability one of success is an increasing function of the intertemporal discount rate, a decreasing function of risk-aversion, an increasing function of the expected foreign wage, an ambiguous function of the domestic wage and a increasing function of the lump sum payment necessary to induce an individual not to leave Senegal. This chapter shows that in addition to determinants of migration such as the expected foreign wage, networks, immigration policies or migration prices, individual preferences matter in the formation of an illegal migration project and can explain the risky behavior of candidates regarding illegal migration.

The remaining part of the chapter is organized as follows: the next section presents a model of the illegal migration intention and the willingness to pay a smuggler with a probability one of success. In Section 3.3 we evaluate theoretically the expressions of the individual's intertemporal discount rate and the individual's coefficient of absolute risk aversion that we calculate in order to make our estimations. Section 3.4 presents the data

and the descriptive statistics obtained from our survey. The estimation strategy and the empirical results are discussed in Section 3.5. Finally the concluding remarks are provided in Section 3.6.

3.2. Migration intention and willingness to pay

3.2.1. The migration intention

Let the monthly wage in Senegal be denoted by w, and the expected wage in the destination country be denoted by w^*. We consider that the timing of migration takes place at time zero. At this moment, we assume that for both potential legal and illegal migrants, the final decision of migration is taken. At time zero, potential legal migrants have the level of skills requiered and their decison to migrate is definitive. Their migration attempt is not a "wait and see" option. For illegal migrants the credit constraint is released at time zero and they get the the necessary funds to finance their migration. The one-shot price of reaching the destination will be denoted by C with associated probability of success p. Illegal migrants do not immediately make another attempt if they are apprehended and sent back to home. It is very likely to assume that if they want to make another attempt, they need to find new financial resources that can take a lot of time and make another attempt unrealizable at time 0.

Consider a simple present discounted value (PDV) calculation, in which t represents the current age of the individual, T his retirement age, and ρ his discount rate. Preferences are assumed to be represented by a utility function denoted by $u(.)$. There is no role for return migration. Then the intertemporal welfare associated with an unsuccessful attempt at leaving Senegal at time 0, and therefore remaining there from time 0 until retirement

at age T, while earning a constant monthly wage w is given by:

$$V^{UE} = u(w - C) + u(w) \sum_{\tau=1}^{\tau=T-t} \frac{1}{(1+\rho)^{\tau}} = u(w - C) + u(w) \frac{1 - (1+\rho)^{t-T}}{\rho}, \tag{3.1}$$

(where the superscript UE stands for unsuccessful emigration). Conversely, we assume that the attempt at emigrating is successful, costs C and results in earning the foreign wage w^* starting at $\tau = 1$. This yields an intertemporal welfare given by:

$$V^{SE} = u(w - C) + u(w^*) \frac{1 - (1+\rho)^{t-T}}{\rho}, \tag{3.2}$$

(where the superscript SE stands for successful emigration). In what follows, we will refer to $\frac{1-(1+\rho)^{t-T}}{\rho}$ as the individual's "intertemporal discount rate". The expected value of the attempt at emigration is therefore given by $E[V] = pV^{SE} + (1-p)V^{UE}$. Substituting from (3.1) and (3.2) yields:

$$E[V] = u(w - C) + [pu(w^*) + (1-p)u(w)] \frac{1 - (1+\rho)^{t-T}}{\rho}. \tag{3.3}$$

Let the intertemporal welfare associated with remaining in Senegal and earning a wage w from $t = 0$ to $t = T$ be given by:

$$\overline{V} = u(w) \frac{(1+\rho) - (1+\rho)^{t-T}}{\rho} \tag{3.4}$$

An individual will attempt to emigrate when $E[V] > \overline{V}$, which can be written, by substituting from (3.3) and (3.4) and simplifying the ensuing expression, as:

$$u(w - C) - u(w) + p[u(w^*) - u(w)] \frac{1 - (1+\rho)^{t-T}}{\rho} > 0. \tag{3.5}$$

The preceding model is, of course, extremely reminiscent of the standard approaches due to Todaro (1969) and Harris and Todaro (1970).

What is the difference between legal and illegal migration in terms of the theoretical model? During the survey, we ask the questions: (1) are you willing to migrate? (2) If you are not able to migrate legally, are you willing to migrate illegally? We put the question this way because we consider that if people have a high probability to succeed a legal migration, they will attempt it. However, the perceptions of most people would be that the likelihood of success of legal migration out of Senegal is significantly lower than the probability of success through illegal migration. Individuals will attempt illegal migration if they do not have any other legal possibility or if they assume that they have no chance of success in a legal migration due to their level of education and/or their social condition. A second characteristic of legal migration is that the associated administrative costs are very low (usually amounting to the cost of the visa application and the documents that must be submitted along with it), though the airfare to the potential destination country does increase the overall price, particularly when compared with the prices of illegal migration methods.

If we allow the expression given in (3.3) to represent the case of illegal migration, and carry out a similar PDV calculation for legal migration,where the probability of success is denoted by $q < p$ and the price is denoted by K, we obtain:

$$E\left[V^{illegal}\right] = u\left(w - C\right) + \left[pu\left(w^*\right) + \left(1 - p\right)u\left(w\right)\right]\frac{1 - \left(1 + \rho\right)^{t-T}}{\rho},$$

$$E\left[V^{legal}\right] = u\left(w - K\right) + \left[qu\left(w^*\right) + \left(1 - q\right)u\left(w\right)\right]\frac{1 - \left(1 + \rho\right)^{t-T}}{\rho}.$$

The individual will then prefer illegal over legal migration when $E\left[V^{illegal}\right] > E\left[V^{legal}\right]$, which can be written explicitly as:

$$u\left(w-C\right)-u\left(w-K\right)+\left(p-q\right)\left(u\left(w^{*}\right)-u\left(w\right)\right)\frac{1-\left(1+\rho\right)^{t-T}}{\rho}>0. \tag{3.6}$$

Consider the two following second-order Taylor expansions:

$$u\left(w-C\right)\approx u(w)-Cu'(w)+\frac{C^{2}}{2}u''(w),$$
$$u\left(w-K\right)\approx u(w)-Ku'(w)+\frac{K^{2}}{2}u''(w).$$

Then one can rewrite (3.6) as:

$$\underbrace{\left(K-C\right)u'(w)\left[1+\frac{1}{2}\left(C+K\right)\left(-\frac{u''(w)}{u'(w)}\right)\right]}_{u(w-C)-u(w-K)}+\left(p-q\right)\left(u\left(w^{*}\right)-u\left(w\right)\right)\frac{1-\left(1+\rho\right)^{t-T}}{\rho}>0. \tag{3.7}$$

One can then immediately establish the following Proposition by straightforward differentiation of (3.7):

Proposition 1. *The likelihood that an individual chooses illegal over legal emigration is: (i) an increasing function of the intertemporal discount rate* $\frac{1-(1+\rho)^{t-T}}{\rho}$*, (ii) an increasing function of the expected foreign wage, (iii) a decreasing function of the price of illegal migration, (iv) an increasing (decreasing) function of risk-aversion when* $K-C>(<)\ 0$

Proposition 1 establishes clear comparative statics results for all variables of interest, with the exception of risk-aversion, for which the comparative statics are ambiguous.

3.2.2. The Willingness to pay a smuggler

We consider the willingness to pay a smuggler with a probability of success equal to 1, which we denote by C^*. This willingness to pay is implicitly defined by the solution in C^* to the following equation:

$$u\left(w - C^*\right) - u\left(w\right) + \left[u\left(w^*\right) - u\left(w\right)\right] \frac{1 - \left(1+\rho\right)^{t-T}}{\rho} = 0.$$

By the same second-order Taylor expansion as above, this can be rewritten as:

$$\left[u\left(w^*\right) - u\left(w\right)\right] \frac{1 - \left(1+\rho\right)^{t-T}}{\rho} - \left[u'(w)C^* - \frac{C^{*2}}{2}u''(w)\right] = 0,$$

or

$$\left[u\left(w^*\right) - u\left(w\right)\right] \frac{1 - \left(1+\rho\right)^{t-T}}{\rho} - u'(w)\left[C^* + \frac{C^{*2}}{2}\left(-\frac{u''(w)}{u'(w)}\right)\right] = 0. \tag{3.8}$$

By the Implicit Function Theorem, one can then immediately establish the following Proposition:

Proposition 2. *The price that an individual is willing to pay a smuggler for an illegal immigration attempt with probability 1 of success is: (i) an increasing function of the intertemporal discount rate* $\frac{1-(1+\rho)^{t-T}}{\rho}$*, (ii) an increasing function of the expected foreign wage, (iii) an ambiguous function of the domestic wage, (iv) a decreasing function of risk-aversion.*

Proof. See the Appendix for details. □

The only ambiguity in the willingness to pay a smuggler for an illegal immigration attempt with probability 1 of success is associated with the effect of the domestic wage. All other comparative statics results for our model –including the effect of risk-aversion– are clear-cut.

3.3. Infering preferences

Let the lump sum payment necessary to induce an individual not to leave Senegal be denoted by D. Indifference between remaining in Senegal and receiving the lump sum payment D at $\tau = 0$ (with associated intertemporal welfare $V^{LS} = u(w+D) + u(w)\frac{1-(1+\rho)^{t-T}}{\rho}$, where the superscript LS stands for lump sum), and the expected value of an attempt at emigration with cost C_j and probability of success p_j (with associated intertemporal welfare $E[V]$) therefore yields $0 = E[V] - V^{LS}$, which can be expressed more explicitly as:

$$0 = u(w - C_j) + [p_j u(w^*) - p_j u(w)] \frac{1-(1+\rho)^{t-T}}{\rho} - u(w+D). \tag{3.9}$$

The reason for indexing the pair (C_j, p_j) by j will become apparent in what follows. If retirement age is considered indefinitely far away by individuals ($T \to \infty$) and individuals are risk neutral ($u(w) = w$) then (3.9) simplifies to $D = \frac{p_j(w^*-w)}{\rho} - C_j$. Given the appropriate data, which include various values of the cost C_j individuals are willing to bear in order to achieve migration success with a given known probability p_j, equation (3.9) allows one to recover both the discount rate ρ and risk aversion in the context of the emigration decision. We show this in the following Proposition.

Proposition 3. *If the individual is willing to emigrate at cost C_j (C_k) with associated probability of success p_j (p_k), and is willing to forego emigration in return for a lump-sum payment D, then:*

(i) the individual's coefficient of absolute risk-aversion is given by

$$A(w) = 2\frac{p_j\left(C_k + D\right) - p_k\left(C_j + D\right)}{p_j\left(D^2 - C_k^2\right) - p_k\left(D^2 - C_j^2\right)};$$

(ii) the individual's discount rate is defined by

$$\frac{1-(1+\rho)^{t-T}}{\rho} = \frac{\left(C_j + D\right)\left(C_k + D\right)\left(C_k - C_j\right)}{\Delta w^*\left[p_j\left(C_k + D\right)\left(C_k + \Delta w^* - D\right) - p_k\left(C_j + D\right)\left(C_j + \Delta w^* - D\right)\right]}.$$

Proof. The proof follows from a second-order Taylor expansion of (3.9), and noticing that the ensuing expression holds for any two gambles (C_j, p_j) and (C_k, p_k). See the Appendix for details. □

For each individual, we have five gambles (C_j, p_j). There are therefore 4+3+2+1 = 10 possible versions of the two expressions given in Proposition 3. For each individual, we can therefore compute a mean value of $A(w)$ and $\frac{1-(1+\rho)^{t-T}}{\rho}$, with an associated standard deviation.

3.4. Data and estimates of preferences

3.4.1. The Survey

In order to examine the intentions and possible triggering factors of illegal migration we conducted a tailor-made survey in Senegal. This study was conducted in Dakar and is exploratory. It does not allow us to generalize our results to all the Senegalese population.

However, since illegal migration from Africa has not been greatly studied, the original data set obtained from this survey can help to fill the gap in the literature and give us the opportunity to understand this phenomenon further.

A random sample of individuals was interviewed between November 2006 and April 2007. Prior to the main survey, a pilot study was conducted in order to be able to adjust for possible biases. There are four sections of the survey: firstly, we elicit a wealth of information about the socio-demographic and economic characteristics of the individuals. Secondly, we elicit the willingness or intentions of individuals to migrate legally or illegally and the motivations behind it. Thirdly, the individuals are asked a detailed battery of questions about the preferred destinations. Fourthly, we are interested in the willingness of the individuals to risk their lives or to take financial risks, for example, by paying a smuggler.

The sampling design was made considering various diversities in Dakar simultaneously. 400 randomly chosen individuals in Dakar were interviewed in different neighborhoods. The survey was conducted in major five regions of Dakar. The first one is the University Campus and its surroundings. Many people belonging to the middle class live in this neighborhood. The second neighborhood is Fass, Medina and Geule-Tapee and the third one is Guediawaye. The second and the third regions are mainly some popular neighborhoods. The fourth level of randomization is Sandaga which is one of the main areas shopping in the city center. Many people coming from the rural sector work there. For some of them, Dakar is the final destination but for many the city is a temporary place for preparing further migration by working in low-paying jobs. Finally, the fifth region is the main departure beaches for illegal migrants namely Kayar, Thiaroye, Yarakh and

Yoff. Since our aim is to explain the illegal migration intentions, the stratification was made in order to identify people having a high propensity to migrate. Consequently we did not include rich regions in Dakar because it is very unlikely that people living in these neighborhoods have to consider migration and illegal migration in particular.[1]

In our survey, we ask people directly: "Are you willing to migrate?" to measure their intentions. 92% of our sample, i.e. 367 individuals, answer yes (Table 3.1). We focus our analysis on individuals willing to attempt legal or illegal migration. To those who wish to migrate we ask the question: "If you are not able to migrate legally, are you willing to migrate illegally?"[2] Among the 367 individuals who wish to migrate 222 report that they would only migrate legally and 145 report that they would migrate illegally. The proportion of people who consider migration is high (92%) and needs to be discussed. We have some variation across regions where we conducted the survey and the proportion of people who wish to migrate is high in all these areas. First of all, it does not mean that all these people will attempt migration. However, some of them will do so. As mentioned above, we measure the intentions of people and we call them potential migrants. In fact, this high number is a very strong indication of the degree of frustration about the economic conditions faces by the average Senegalese individual.

[1]These people are in most cases highly educated, much wealthier than the average population and have good living conditions in Senegal. Moreover, when they have to go abroad they are able to provide reliable documents to consular officials and do not have any issue with traveling legally.

[2]We ask the question in this form, because we assume that if people have the opportunity to migrate legally they will naturally go towards this type of migration. In the Senegalese context, it is very likely that people attempting illegal migration have the perceptions that, because of their low level of qualifications, the instability or the weakness of their professional situation, obtaining legitimate documents would be difficult for them. Attempting legal migration would be a waste of time and therefore, they will restrict themselves to ask for legal documents.

3.4.2. Descriptive statistics

[Table 3.1 HERE]

The summary statistics are presented in Table 3.1. 40% of potential migrants are willing to migrate illegally. This high proportion of people willing to attempt illegal migration shows their determination to migrate whatever the risks. The average monthly expected wage of a potential migrant is 1 567 466 Fcfa, i.e. 2 389 Euros. The wage in Senegal is approximated by the average monthly expenditure of individuals because people answer more easily about their expenditures that makes more reliable this variable than the income. The average monthly expenditure is estimated at 76 055 Fcfa, i.e. 115.94 Euros which is very low compared to the expected wage. 68% of potential migrants report that they will not forgo the idea of migrating if there is a tightening of immigration policies. This variable means that the conditions to enter the destination countries are made more restrictive. These conditions can be related to the quotas of immigrants, the education level or to stricter border controls of the destination countries. 3.74% of potential migrants have some family or friends' relatives who have migrated. The average migration price is 2 220 254 Fcfa (2335 Euros) which is very high. Men represent 88% of the sample of potential migrants. This proportion is explained by the fact that people reachable in the different neighborhoods were mainly male which is consistent with our aim of reaching the part of the population with a high intention to migrate. The average age is 26 years old. Married people represent 26% of the sample and 84% of people have at least one male dependent child. 42% of potential migrants have a low level of education and this proportion decreases gradually with secondary and university level of education. 56% of potential migrants live in a house that belongs to them or their family. Mouride is a

dummy equal to one if people belong to this religious brotherhood. Senegal is composed of 94% of Muslim people, 5% of Christian people and 1% of Animist people. A lot of Muslim people are affiliated to different brotherhoods headed by a spiritual guide and Mouride is one of the most important brotherhoods in Senegal. People belonging to the Mouride brotherhood represent 45% of potential migrants.

[FIGURE 3.1 HERE]

[FIGURE 3.2 HERE]

The average individual's discount rate is equal to 0.91 for potential illegal migrants. When we look more specifically at the distribution of this variable (Figure 3.1), 64% of potential migrants have a discount rate above 0 and 28% of them have a discount rate above 0.8. Figure 3.2 shows the histogram of the mean value of the individual's coefficient of absolute risk aversion $A(w)$. We calculate these values from proposition 3 of the theoretical model. We observe that the individual's coefficients of absolute risk aversion are very close to 0 which means that the individuals are risk neutral. They do not care about risks they take with illegal migration which is a strong signal of their determination. In order to have more variability than the mean value of individual's coefficients of absolute risk aversion $A(w)$, we create a dummy equal to one if potential illegal migrants are risk-averse (the mean value of individual's coefficients of absolute risk aversion is positive) and 0 if they are risk-loving (the mean value of individual's coefficients of absolute risk aversion is negative). It is this dummy variable that we are going to use in the estimations.

[TABLE 3.2 HERE]

Results shown in Figure 2 are confirmed in Table 2 where we present the descriptive statistics of the willingness to pay a smuggler associated with different probabilities of success for those who are willing to migrate illegally. We observe that the lower the probability of success, the lower is the share of individuals who are willing to migrate illegally. However, this proportion remains high compared to the risk taken. Indeed, with a probability of success of 5%, 53% of people are still willing to migrate illegally. Moreover, the difference between their willingness to pay with a probability of success of one and a probability of success of 0.05 is quite low. It is estimated at only 216 356 Fcfa, i.e. 329 Euros. These amounts are high in the case of Senegal but they are very realistic. The willingness to pay a smuggler with a probability equal to one corresponds approximately to the monthly expected wage of potential migrants. Migrants are well informed about different prices in the illegal migration market. Thus, it is likely that if they finance their migration by a loan, for instance, they plan to repay the smuggler with their first wage earned in the host country. The average lump sum payment necessary to induce an individual not to leave Senegal (D) is equal to 1.76e+09 Fcfa (2 680 638 Euros). This amount is an indication of the large utility gap of potential migrants between migrating or remaining in Senegal.

3.5. Econometric strategy and results

3.5.1. Estimation strategy

The aim of this section is to empirically test our theoretical predictions. However, since the individual preferences variables are also only available for the potential illegal migrants, we are not able to test the theoretical predictions of the effect of these variables on the

illegal migration intention but only on the willingness to pay a smuggler. Individuals will pay a smuggler only if they are willing to migrate illegally. Therefore, the willingness to pay is observed only for the part of the sample willing to migrate illegally. In this case, we do not have a random selection. Then, to avoid a selection bias and a specification error, we use a Heckman procedure (Heckman, 1979). We estimate the selection equation by a probit model and the outcome equation by a linear model. Then we have:

$$\text{Outcome equation: } y_i = x_i\beta + w_i\gamma + \lambda_i\eta + \alpha_r + \varepsilon_i \tag{3.10}$$

$$\text{Selection equation: } m_i = \begin{cases} 1 \; if \; x_i\beta + z_i\theta + \alpha_r + \mu_i > 0 \\ 0 \; if \; x_i\beta + z_i\theta + \alpha_r + \mu_i \leq 0 \end{cases} \tag{3.11}$$

Where:

$$y_i \text{ is observed only when } m_i = 1$$

$$\varepsilon_i \sim N(0, \sigma)$$

$$\mu_i \sim N(0, 1)$$

$$corr(\varepsilon_i, \mu_i) = \upsilon$$

In equation (3.10), y_i represents the logarithm of the willingness to pay a smuggler with a probability one of success. (w_i) is the vector of interest variables. (w_i) includes the mean value of the individual's discount rates represented by $\frac{1-(1+\rho)^{t-T}}{\rho}$ and a dummy equal to one if the individual is risk-averse. These values are calculated from the proposition 3 in the theoretical model and γ is the vector of parameters to be estimated. x_i is the vector

of control variables including variables considered as triggering factors of illegal migration such as the logarithm of the expected monthly foreign wage per capita, the logarithm of migration prices, immigration policies measured by a dummy equal to one if individuals will not give up on migration in case of a tightening of immigration policies, a dummy equal to one if individuals have family or friends' relatives who have migrated. This variable allows us to take into account the network effects. x_i also includes the socio-demographic characteristics such as the logarithm of the monthly wage in Senegal per capita[3], gender, age, marital status, dummy equal to one if the individual has male dependent child, home occupation status (dummy equal to one if the individual and his family live in their own home), a dummy equal to one if the individual belongs to the Mouride brotherhood and indicator variables for ethnic groups. β is the vector of parameters to be estimated. As mentioned in the third section, there are mainly five regions in Dakar where we collected our data. In order to capture unobserved regional characteristics, we control equation (3.10) for five regional dummies (α_r).

In the selection equation (equation 3.11), m_i is the binary variable equal to one if the individual reports a possibility for illegal migration and 0 otherwise; x_i is the same vector of control variables included in the outcome equation and z_i is the exclusion variable represented by different levels of education. We assume that the level of education influences the intention to migrate illegally but not the willingness to pay a smuggler with a probability one of success because expected returns from skills for an illegal migration are very low. First, this is due to the fact that illegal migrants are generally less skilled than legal

[3]The monthly wage in Senegal per capita is approximated by the average monthly expenditure of the individuals divided by the number of dependents. We divided the average monthly expenditures of the individuals by 1+ the number of dependents and also the foreign expected wage by 1 + the number of dependents to take into account the burden of responsibilities that may influence the method of migration.

migrants. They tend to invest less in human capital due to a higher risk of apprehension (Chiswick, 1999). However, it is also shown in the literature that with the same characteristics illegal migrants are less paid than legal migrants due to their shorter expected duration in the destination and the limitations of their the job mobility (Kossoudji and Cobb-Clark, 2002; Rivera-Batiz, 1999). For instance Rivera-Batiz (1999) shows that even if illegal migrants are less educated, get worse language proficiency and have a shorter period of residence in the U.S. than legal migrants, the gap between the earnings of illegal and legal migrants is mainly explained by the illegal status of undocumented workers who are exploited by their employers. This gap is decreased more by the legalization of illegal migrants than by the changes in the characteristics of migrants. Moreover, illegal migrants are used to work in low-paid jobs (Taylor, 1992) where their qualifications, if they exist, are not fully expoited because of their illegal status.

3.5.2. Results

[TABLE 3.3 HERE]

Table 3.3 reports the results of the Heckman procedure. Our results show that the willingness to migrate illegally is an increasing function of the foreign expected wage which confirms our theoretical predictions (Column 1). Great expectations can increase migration intentions (Dalen et al., 2005; De Jong, 2000) and our results show that this is particularly true in the case of illegal migration. The expected wage value can often be evaluated on what potential migrants think about the salaries of their relatives who have already migrated. Relatives can give information (biased or not) about their living conditions in the host country that can spark off the desire to migrate illegally for

those remaining in the origin country. This is confirmed by the results of the variable relatives. We find that having family and friends' relatives who have already migrated increases significantly the likelihood to migrate illegally. We use the variable relatives as a proxy of the network effects that are integrated in migration plans because they help to reduce migration costs (Munshi, 2003; Carrington et al., 1996). Networks are a source of information on the locations and affect the destination choice of migrants (Epstein and Gang, 2006). In the specific case of illegal migration, networks give some information and some assistance about the financing of the illegal migration or the procedure to follow to migrate illegally (Dolfin and Genicot, 2010). Another triggering factor that we consider in our estimations is the variable tightening of immigration policies. This variable is positive and significantly different from 0 at a level of 1%. It means that people will not forgo illegal migration in the case of tight immigration policies to enter the host countries. Therefore, contrary to the initial objectives, these policies may have pernicious effects by discouraging legal migration and by involving increased flow of illegal migrants. These results are a reminder of those of Orrenius (2004) and Gathman (2008) that show that restrictive immigration policies measured by an enforcement of the border controls between Mexico and the U.S. have a small deterrent effect on illegal migration flows. There is a negative relationship between migration prices and the likelihood to migrate illegally. The main reason is that illegal migration is an expensive project which requires large funds that the poorest cannot afford. These amounts often involve taking loans to finance migration or years of savings. The result of the level of education that represents our exclusion variable show that having a university level of education strongly reduces the likelihood to migrate illegally compared to having a low level of education. This variable

is positive and significant at a level of 1%. This result can be explained by the fact that educated and skilled people have better living conditions and have also a higher likelihood of obtaining legitimate documents for legal migration.

The results of the outcome equation are reported in Column 2 of Table 3.3. The results show that our theoretical propositions are confirmed by our estimations. We find that the average individual's discount rate is significantly and positively related to the willingness to pay a smuggler with a probability one of success. If the individual's preference for the present is higher, the potential illegal migrant has a higher willingness to pay a smuggler with a probability one of success. A legal procedure can take a lot of time and many attempts without any guarantee of success. Consequently, individuals who are willing to be engaged in illegal migration are also willing to pay a smuggler more to immediately improve their living conditions. The risk aversion dummy is significant and decreases the willingness to pay a smuggler. The willingness to pay a smuggler with a probability one of success will be 65% lower for risk-averse than for risk-loving people. The explanation being that paying a smuggler induces *de facto* a financial risk associated with the nature of the project that only the most determined can take. Moreover, the behavior of these less risk averse individuals can be a sort of signal for the smugglers to determine the most risky "clients" and raise their prices for this category of people.[4] The higher the expectations, the higher will be the amount that people are willing to pay to guarantee them a successful migration. For an increase of 10% in the foreign expected wage per capita, the willingness

[4]According to Pratt (1964) the risk premium is a positive monotonic function of the risk aversion. However in some cases, the WTP may negatively be related to the degree of risk aversion. A risk-neutral individual can have a higher willingness to pay than a risk-averse individual for a partial reduction of risk (Eeckhoudt et al., 1997; Langlais, 2005)

to pay a smuggler with a probability one of success will be increased by 1.78%. However, the wage earned in Senegal does not appear significant which confirms the ambiguous function of this variable in our theoretical predictions. The migration prices become insignificant at the second step which shows that potential migrants once they are willing to migrate illegally are strongly motivated and the migration prices no longer constitute a constraint in their willingness to pay a smuggler. Potential illegal migrants who do not forgo migration in the case of a tightening of immigration will decrease their willingness to pay a smuggler in order to have more chances to achieve the project. This result is significant at a level of 5%. The Inverse Mills Ratio is not significant, which means that there is no selection bias.[5]

Columns 3 and 4 present the results of the estimations with the lump sum payment necessary to induce an individual not to leave Senegal as variable of interest. The lump sum payment is also a measure of the individual preferences because it captures the monetary value given to migration and gives an indication of the utility gap between migrating or remaining in Senegal. The lump sum payment is not significant at the first step which means that is does not affect the likelihood to migrate illegally instead of legally. However, for potential illegal migrants, there is a positive relationship between the lump sum payment and the willingness to pay a smuggler. An increase of 10% in the lump sum payment increases by 1.45% the willingness to pay a smuggler with a probability one of success. This result means that the more potential illegal migrants give

[5]The observations are 332 instead of 367 because of missing values due first to the wage in Senegal, even if we take the monthly expenditure as proxy of this variable that already allows us to decrease the number of missing values. Second, it is due to indetermined discount rates and coefficients of absolute risk aversion for some individuals who decide to not migrate from a certain probability of success lower than one. For these people we cannot form all the gambles (C_j, p_j) necessary to calculate the variables of preferences.

a high value to migration, the more they are willing to pay a smuggler in order to succeed in their illegal migration project. Then, the higher the lump sum payment necessary to induce an individual not to leave Senegal, the higher is the utility gap between migrating or remaining in Senegal.

3.6. Concluding remarks and implications

The aim of this chapter is to show the role of time and risk preferences in the illegal migration intentions and the willingness to pay a smuggler. From a theoretical model, we study how these variables affect illegal migration intention and the willingness to pay a smuggler with a probability one of success. We also define theoretically two expressions of time and risk preferences that we use later in our estimations. One of the novelties of the chapter is to use an original data set from a tailor-made survey among potential migrants in Senegal to test our theoretical predictions.

Our comparative statistics show that first, the likelihood to migrate illegally is an increasing function of the intertemporal discount rate, an ambiguous function of the risk aversion, an increasing function of the expected foreign wage and a decreasing function of the price of illegal migration. Second, the price that an individual is willing to pay a smuggler for an illegal immigration attempt with probability one of success is an increasing function of the intertemporal discount rate, a decreasing function of risk-aversion, an increasing function of the expected foreign wage, an ambiguous function of the domestic wage. We could empirically test all our theoretical predictions except the effect of the the intertemporal discount rate and the risk aversion on the illegal migration intention due to the non availability of the data for potential legal migrants. All other theoretical

predictions are confirmed by the empirical estimations. The empirical results also show that the willingness to pay a smuggler is an increasing function of the lump sum payment necessary to induce an individual not to leave Senegal. We find that in addition to the determinants of migration such as the expectations, presence of relatives in the destination country, immigration policies or migration prices, individual preferences measured by the intertemporal discount rate and the risk aversion matter in the illegal migration intention. Moreover the positive relationship between the lump sum payment necessary to induce an individual not to leave Senegal and the willingness to pay a smuggler means that potential illegal migrants give a high monetary value to illegal migration and have a high utility gap between migrating and remaining in Senegal.

Individual preferences have then to be considered in the explanation of illegal migration and also in the probable non efficiency of immigration policies that do not take into account the determination and the "emergency" that potential illegal migrants have to improve their living conditions.

Table 3.1. Summary statistics

Variables	Mean	SD	Obs
Migrate illegally	0.40	0.49	367
Willingness to pay	1 480 556	2 004 192	144.
Average discount rate	0.91	3.32	138
Risk aversion	0.92	0.27	138
Lump sum payment	1.76e+09	2.34e+10	294
Expected foreign wage	1 567 466	5 486 186	363
Expected foreign wage per capita	893 918	5 332 343	363
wage	76 054.93	64 698.93	343
Wage per capita	21 481.92	16 979.35	343
Tightening of immigration policies	0.68	0.47	367
Relatives	0.74	0.44	367
Migration prices	2 220 254	1 756 592	367
Male	0.88	0.33	367
Age	25.96	07.18	367
Married	0.26	0.44	367
Child is male	0.84	0.37	367
Low education level	0.42	0.49	367
Secondary level	0.27	0.44	367
University level	0.16	0.37	367
Koranic school	0.15	0.36	367
Home owner	0.56	0.50	367
Mouride	0.45	0.50	367
Wolof ethnic group	0.34	0.47	367
Lebou ethnic group	0.19	0.39	367
Hal Pular ethnic group	0.11	0.32	367
Serere ethnic group	0.23	0.42	367
Diola ethnic group	0.05	0.23	367
Manjack ethnic group	0.01	0.10	367
Bambara, Mandingue and Sub-region ethnic group	0.07	0.26	367
Region of Campus	0.11	0.32	367
Region of Fass, Medina and Geule tapée	0.11	0.31	367
Region of Guédiawaye	0.36	0.48	367
Region of Sandaga	0.12	0.33	367
Region of Kayar, Thiaroye, Yarakh and Yoff	0.30	0.46	367

Notes : Prices are in Fcfa. 1 Euro= 656.56 Fcfa.

Table 3.2. Probabilities of success and willingness to pay a smuggler of potential illegal migrants

	Mean	Sd	Obs
How much are you willing to pay if p = 1?	1 480 556	2 004 192	145
If p = 0.75, are you willing to migrate?	0.85	0.36	145
If yes, how much are you willing to pay?	1 351 829	1 952 752	123
If p = 0.50, are you willing to migrate?	0.77	0.43	145
If yes, how much are you willing to pay?	1 311 261	1 994 398	111
If p= 0.25, are you willing to migrate?	0.62	0.49	145
If yes, how much are you willing to pay ?	1 315 611	1 792 507	90
If p = 0.05, are you willing to migrate?	0.53	0.50	145
If yes, how much are you willing to pay?	1 264 200	1 592 063	75

Note: 1 Euro=656.56 Fcfa

Table 3.3. Preferences and willingness to pay a smuggler: Heckman procedure

Variables	Selection	Outcome	Selection	Outcome
	(1)	(2)	(3)	(4)
Average discount rate		0.081***		
		(3.17)		
Risk aversion		-1.052***		
		(2.94)		
Log lump sum payment			-0.010	0.151***
			(0.18)	(3.19)
Log expected foreign wage per capita	0.162*	0.185**	0.200**	0.187**
	(1.85)	(2.10)	(2.15)	(2.05)
Log wage per capita	-0.026	-0.006	-0.000	-0.139
	(0.19)	(0.05)	(0.00)	(1.15)
Tightening of immigration policies	0.589***	-0.780***	0.543**	-0.600**
	(2.72)	(3.10)	(2.31)	(2.33)
Relatives	0.565**	0.041	0.412	0.219
	(2.12)	(0.13)	(1.43)	(0.76)
Migration prices	-1.008***	0.287	-1.031***	0.196
	(8.75)	(1.13)	(8.27)	(0.72)
Education level				
Secondary level	-0.141		-0.203	
	(0.63)		(0.82)	
University level	-1.428***		-1.211**	
	(2.88)		(2.17)	
Koranic school	-0.234		-0.187	
	(0.81)		(0.60)	
Individual characteristics	Yes	Yes	Yes	Yes
Inverse Mills Ratio		-0.403		-0.278
		(0.80)		(0.51)
Observations	332		280	

Notes : Robust z-statistics in parentheses: * significant at 10%;** significant at 5%; *** significant at 1%. The reference category of the education level is low level. Individual characteristics include the gender, the age, a dummy equal to one if the individual has a male child dependent, a dummy equal to one if the individual or his family lives in their own house, religious and ethnic dummies. Estimations also include region dummies. Full estimations are available upon request.

Figure 3.1. Individual's discount rate

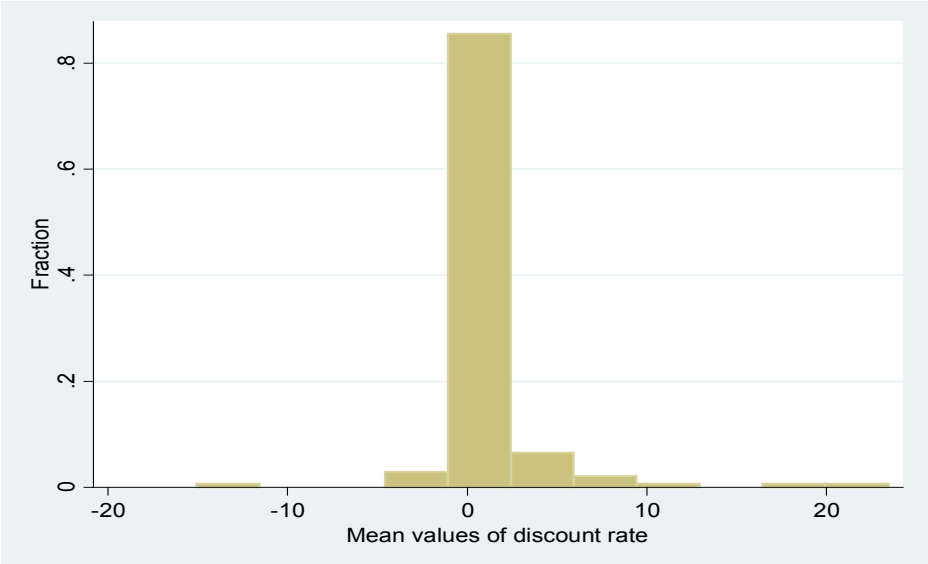
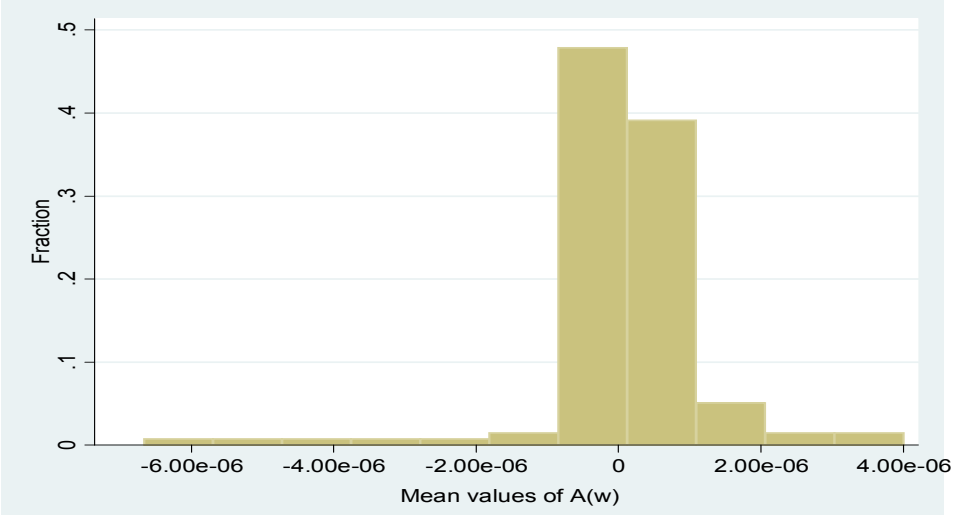


Figure 3.2. Individual's coefficients of absolute risk aversion



Appendix

A.1 Proof of Proposition 2

Applying the Implicit Function Theorem to (3.8) yields:

$$\frac{dC^*}{d\left(\frac{1-(1+\rho)^{t-T}}{\rho}\right)} = -\frac{u\left(w^*\right)-u\left(w\right)}{\underbrace{-\left[u'(w)-C^*u''(w)\right]}_{<0}} > 0,$$

$$\frac{dC^*}{dw^*} = -\frac{u'\left(w^*\right)\frac{1-(1+\rho)^{t-T}}{\rho}}{\underbrace{-\left[u'(w)-C^*u''(w)\right]}_{<0}} > 0,$$

$$\frac{dC^*}{dw} = -\frac{-u'\left(w\right)\frac{1-(1+\rho)^{t-T}}{\rho}-\left[u''(w)C^*-\frac{C^{*2}}{2}u'''(w)\right]}{\underbrace{-\left[u'(w)-C^*u''(w)\right]}_{<0}} \lessgtr 0,$$

$$\frac{dC^*}{d\left(-\frac{u''(w)}{u'(w)}\right)} = -\frac{-u'(w)\frac{C^{*2}}{2}}{\underbrace{-\left[u'(w)-C^*u''(w)\right]}_{<0}} < 0. \ [QED]$$

A.2 Proof of Proposition 3

Consider second-order Taylor expansions of the elements of (3.9): $u\left(w-C\right) \approx u(w) - Cu'(w) + \frac{C^2}{2}u''(w)$; $u\left(w^*\right) = u\left(w+\Delta w^*\right) \approx u(w) + \Delta w^* u'(w) + \frac{\Delta w^{*2}}{2}u''(w)$, $u\left(w+D\right) \approx$

$u(w) + Du'(w) + \frac{D^2}{2}u''(w)$. Substitution into (3.9) then yields:

$$0 = \underbrace{u(w) - C_j u'(w) + \frac{C_j^2}{2}u''(w)}_{u(w-C_j)}$$
$$+ \left[p_j \underbrace{\left(u(w) + \Delta w^* u'(w) + \frac{\Delta w^{*2}}{2}u''(w) \right)}_{u(w^*)} + (1 - p_j)\, u\,(w) \right] \frac{1 - (1+\rho)^{t-T}}{\rho}$$
$$- \left[\underbrace{u(w) + Du'(w) + \frac{D^2}{2}u''(w)}_{u(w+D)} + u\,(w)\, \frac{1 - (1+\rho)^{t-T}}{\rho} \right].$$

Dividing by $u'(w)$ and letting $A(w) = -\frac{u''(w)}{u'(w)}$ allows one to simplify this expression to:

$$(3.12)\quad 0 = -C_j - \frac{C_j^2}{2}A(w) + p_j \Delta w^* \left[1 - \frac{\Delta w^*}{2}A(w) \right] \frac{1 - (1+\rho)^{t-T}}{\rho} - \left[D - \frac{D^2}{2}A(w) \right].$$

Now this indifference relationship holds for any gamble $.(C_j, p_j)$. It follows, for gambles (C_j, p_j) and (C_k, p_k), that $-C_j - \frac{C_j^2}{2}A(w) + p_j \Delta w^* \left[1 - \frac{\Delta w^*}{2}A(w)\right] \frac{1-(1+\rho)^{t-T}}{\rho} = -C_k - \frac{C_k^2}{2}A(w) + p_k \Delta w^* \left[1 - \frac{\Delta w^*}{2}A(w)\right] \frac{1-(1+\rho)^{t-T}}{\rho}$, and thus that:

$$(3.13)\quad 0 = C_j - C_k + \left(\frac{C_j^2}{2} - \frac{C_k^2}{2} \right) A(w) + (p_k - p_j)\, \Delta w^* \left[1 - \frac{\Delta w^*}{2}A(w) \right] \frac{1 - (1+\rho)^{t-T}}{\rho}.$$

Combining equations (3.12) and (3.13) then allows one to solve for the discount rate ρ and the coefficient of absolute risk-aversion $A(w)$ as given in the Proposition. $[QED]$

References

[1] Barsky, R. B; Juster, F., T.; Kimball, M., S., Shapiro, M., D., (1997): "Preference Parameters and Behavioral Heterogeneity: An Experimental Approach in the Health and Retirement Study", *The Quarterly Journal of Economics,* 112(2), 537-79.

[2] Carrington, W. J.; Detragiache, E. and Vishwanath, T. (1996): "Migration with Endogenous Moving Costs", *The American Economic Review*, 86(4), pp. 909-930.

[3] Chiswick, B. R. (1999): "Are Immigrants Favorably Self-Selected?", *The American Economic Review,* 89(2), 181-185.

[4] Dalen, H. V.; Groenewold, G. and Schoorl, J. (2005a): "Out of Africa: what drives the pressure to emigrate?", *Journal of Population Economics*, 18, 741-778.

[5] Daveri, F. and Faini, R. (1999): "Where Do Migrants Go?", *Oxford Economic Papers*, 51(4), 595-622.

[6] Dolfin, S. and Genicot, G. (2010): "What Do Networks Do? The Role of Networks on Migration and "coyote" use", *Review of Development Economics*, 14(2), 343-359.

[7] Dror, D. M.; Radermacher, R. and Koren, R. (2007): "Willingness to pay for health insurance among rural and poor persons: Field evidence from seven micro health insurance units in India", *Health Policy*, 82(1), 12 - 27.

[8] Eeckhoudt, L.; Godfroid, P. and Gollier, C. (1997): "Willingness to pay, the risk premium and risk aversion", *Economics Letters,* 55(3), 355-360.

[9] Epstein, G. S. and Gang, I. N. (2006): "The Influence of Others on Migration Plans", *Review of Development Economics,* 10(4), 652-665.

[10] Friebel, G. and Guriev, S. (2006): "Smuggling Humans: A Theory of Debt-financed Migration", *Journal of the European Economic Association,* 4(6), 1085-1111.

[11] Gathmann, C. (2008): "Effects of enforcement on illegal markets: Evidence from migrant smuggling along the southwestern borde", *Journal of Public Economics*, 92(10-11), 1926-1941.

[12] Gustafsson-Wright, E.; Asfaw, A. and Van Der Gaag, J. (2009): "Willingness to pay for health insurance: An analysis of the potential market for new low-cost health insurance products in Namibia", *Social Science & Medicine,* 69(9), 1351-1359.

[13] Hanemann, W. M. (1994): "Valuing the Environment through Contingent Valuation", *Journal of Economic Perspectives,* 8(4), 19-43.

[14] Harris, J. R. and Todaro, M. P. (1970): "Migration, Unemployment and Development: A Two-Sector Analysis", *The American Economic Review*, 60(1), 126-142.

[15] Hanson, G. H. (2006): "Illegal Migration from Mexico to the United States", *Journal of Economic Literature*, 44(4), 869-924.

[16] Hanson, G. H. and Spilimbergo, A. (1999): "Illegal Immigration, Border Enforcement, and Relative Wages: Evidence from Apprehensions at the U.S.-Mexico Border", *American Economic Review*, 89(5), 1337-1357.

[17] Heckman, J. J. (1979): "Sample Selection Bias as a Specification Error", *Econometrica*, 47(1), 153-61.

[18] Heitmueller, A. (2005): "Unemployment benefits, risk aversion, and migration incentives", *Journal of Population Economics*, 18(1), 93-112.

[19] Jong, G. F. D. (2000): "Expectations, Gender, and Norms in Migration Decision-Making", *Population Studies*, 54(3), 307-319.

[20] Kossoudji, S. A. and Cobb-Clark, D. A. (2002): "Coming out of the Shadows: Learning about Legal Status and Wages from the Legalized Population", *Journal of Labor Economics,* 20(3), 598-628.

[21] Langlais, E. (2005): "Willingness to Pay for Risk Reduction and Risk Aversion without the Expected Utility Assumption", *Theory and Decision,* 59(1), 43-50.

[22] Munshi, K. (2003): "Networks In The Modern Economy: Mexican Migrants In The U.S. Labor Market", *The Quarterly Journal of Economics*, 118(2), 549-599.

[23] Nowotny, K. (2010): "Risk Aversion, Time Preference and Cross-border Commuting and Migration Intentions", Technical report, WIFO.

[24] N'Guessan, C., F., J., (2008): "Le consentement des ménages ruraux à payer une prime d'assurance maladie en Côte d'Ivoire", *Revue d'économie du développement*, 22(1), 101-124.

[25] Massey, D. S. and Espinosa, K. E. (1997): "What's Driving Mexico-U.S. Migration? A Theoretical, Empirical, and Policy Analysis", *American Journal of Sociology*, 102(4), 939-99.

[26] Orrenius, P. (2004): "The Effect of U.S. Border Enforcement on the Crossing Behavior of Mexican Migrants" In Crossing the Border: Research from the Mexican Migration Project, Jorge Durand and Douglas S. Massey, eds., Russell Sage Foundation.

[27] Orrenius, P. M. and Zavodny, M. (2005): "Self-selection among undocumented immigrants from Mexico", *Journal of Development Economics*, 78(1), 215-240.

[28] Paiella, M. and Guiso, L. (2004): "The Role of Risk Aversion in Predicting Individual Behaviour", Technical report, Econometric Society.

[29] Pratt, J. W. (1964): "Risk Aversion in the Small and in the Large", *Econometrica,* 32(1/2), 122-136.

[30] Rivera-Batiz, F. L. (1999): "Undocumented workers in the labor market: An analysis of the earnings of legal and illegal Mexican immigrants in the United States", *Journal of Population Economics*, 12(1), 91-116.

[31] Singer, A. and Massey, D. S. (1998): "The Social Process of Undocumented Border Crossing among Mexican Migrants", *International Migration Review*, 32(3), pp. 561-592.

[32] Protière, C.; Donaldson, C.; Luchini, S.; Moatti, J. P. and Shackley, P. (2004): "The impact of information on non-health attributes on willingness to pay for multiple health care programmes", *Social Science & Medicine,* 58(7), 1257 - 1269.

[33] Sengupta, B. and Hegde, S. A. (2005): "Willingness to Pay for Legal Visas: A Case Study of Agricultural Workers in Southern California", Technical report, American Agricultural Economics Association (New Name 2008: Agricultural and Applied Economics Association).

[34] Taylor, J. E. (1992): "Earnings and Mobility of Legal and Illegal Immigrant Workers in Agriculture", *American Journal of Agricultural Economics,* 74(4), 889-896.

[35] Todaro, M. P. (1969): "A Model of Labor Migration and Urban Unemployment in Less Developed Countries", *The American Economic Review* 59(1), 138–148.

[36] Torero, M.; Chowdhury, S. K. and Galdo, V. (2003): "Willingness to pay for the rural telephone service in Bangladesh and Peru", Information Economics and Policy, 15(3), 327-361.

[37] Verbic, M. and Slabe-Erker, R. (2009): "An econometric analysis of willingness-to-pay for sustainable development: A case study of the Volcji Potok landscape area", *Ecological Economics*, 68(5), 1316-1328.

[38] Whittington, E. A. (1990): "Estimating the Willingness to Pay for Water Services in Developing Countries: A Case Study of the Use of Contingent Valuation Surveys in Southern Haiti", *Economic Development and Cultural Change,* 38(2), 293-311.

Chapter 4

Migration and credit markets: Evidence from rural Senegal

4.1. Introduction

Migration plays a crucial role in developing countries. In Africa, migrants are around 30 million i.e. 3% of the population and migrants' transfers are estimated at 40 billion $ in 2010. As in many developing countries, in Senegal, the proportion of formal loans remains low due to many factors including the lack of guarantee given by borrowers, even if the development of microfinance institutions has improved the penetration of banking services.[1] The aim of this chapter is to contribute to the empirical literature related to the impact of migrants in the recipient countries in the context of rural credit markets. The

[0]Earlier versions of this chapter were presented at the ASSA meeting in Chicago and the IZA Brown Bag Seminar in Bonn. I thank Kwabena Gyimah-Brempong and conference participants for useful comments and suggestions. The usual disclaimer applies.

[1]The penetration rates of banking services, including microfinance institutions, is estimated to 19% in 2010 according to the Central Bank of West Africa States

effect of migration on the recipient countries has above all been studied with regard to the effect of remittances. It is widely demonstrated that remittances have strong effects in the recipient countries, above all in Africa, by helping to reduce poverty and inequality (Gubert et al. 2010), for instance. In developing countries where incomes are often low, insufficient and highly variable, remittances have a stabilizing and smoothing effect on consumption, insuring the recipient households by strongly responding to negative shocks (Gubert, 2002; Yang, 2008; Combe and Ebeke, 2011) and reducing household income volatility (Yang and Choi, 2007; Amuedo-Dorantes and Pozo, 2011). Using the example of Guatemala , Adams and Cuecuecha (2010) show, after correcting for selection and endogeneity issues, that remittances have a positive impact on economic development through investment in human and physical capital in developing countries. According to this study, households receiving remittances spend more on education and housing and less on consumption goods than households that do not receive transfers. Migration and remittances can then help to deal with credit market imperfections and to relax the credit constraint (Mesnard, 2004) by increasing investments and developing small enterprises (Woodruff and Zenteno, 2007). In the case of the credit markets, Aggarwal et al., (2011) show that workers' transfers by increasing deposits and credits intermediated by the local banking sector, contribute to the development of the financial sector and then have a positive impact on economic development. Demirgüç-Kunt et al., (2011) confirm this effect by showing in the case of Mexico that remittances increase the number of branch, accounts and deposits in the recipient country, which positively affects the depth and breadth of the banking sector. These authors find in their study a positive impact of remittances on the share of credit volume year to GDP. However, this effect is less robust

to the instrumentation of remittances. In the Sub-Saharan Africa context, Gupta et al. (2009) find that remittances improve the financial development, in origin countries of migrants by facilitating the access of poor households to the formal financial markets. However this positive effect of remittances on the financial sector is put into perspective by Brown et al. (2011) who find a negative relationship between remittances and the financial deepening in developing countries. More specifically, the effect of remittances on rural credit markets has been studied by Richter (2008) who analyzes the effect of potential receipt of remittances on credit demand of rural households in the Mexican state of Oaxaca and her results suggest that the predicated amount of remittances received at the household level have a positive effect on credit demand. According to Richter (2008) and Aggarwal et al. (2011), the effect of remittances on credit markets is à priori ambiguous. They argue that remittances can not only provide insurance to households and increase their willingness to participate in the credit markets but they can also reduce credit demand by relaxing the financial constraints.

As mentioned in the previous literature, migrants through their transfers can have an impact on the financial sector. However, in this chapter we look at the effect of migrants themselves and not the effect of remittances on credit variables. We assume that migrants can also influence the credit markets by being the collateral, the "third element" or the "element of trust" in the credit contract between the borrower and the lender because they represent a potential solution and can play an insurance role in case of non repayment. Therefore, we are interested in the relationship between having a migrant in a household and the likelihood for a household to have a loan and on the size of the loan. We are going to answer the question "How do migrants affect rural credit

markets in an African context?". However, we suspect an endogeneity issue of migration variable due to the potential reverse causality between loans taken by households and the likelihood of having a migrant in a household. If having a migrant in a household can explain the likelihood of having a loan and the loan size, loans can allow the financing of the migration of one or many household members. To correct for the potential reverse causality, we choose to instrument the variable having a migrant in a household with a dummy variable equal to one if there is a mobile phone in the household. Recent literature shows how mobile phones can influence migration by giving information about the job opportunities in the destination countries (Aker et al., 2011). We argue that the variable mobile phone is exogenous and not correlated to the error term because mobile phones are widely present in Senegal, even in rural areas, their costs have greatly decreased, they are easily lost or stolen and thus cannot be considered as a durable asset used to guarantee a loan.

Data are provided by a program of impact evaluation of multifunctional platforms which allow access to energy in rural areas in Senegal. The survey includes two waves and the first wave was made between June and July 2009 in villages with and without platforms. In this chapter we use the survey data of the first stage to realize a cross-section analysis. After controlling for potential endogeneity issue, results show that having a migrant in a household increases both the likelihood for an individual to have a loan in a household and the loan size whether the loan is formal or informal. We also find that this positive effect remains significant if the loan is taken for professional activities or for food consumption reasons.

The chapter is organized as follows: the next section presents the conceptual framework. In Section 4.3, we present data and descriptive statistics. The empirical strategy is given in Section 4.4 while the results are discussed in section 4.5. Concluding remarks are provided in the last section.

4.2. Conceptual framework

First of all, we assume that having a migrant in a household can increase the likelihood of getting a loan and the loan size. As shown in the previous literature, migrants through their remittances play an insurance role against shocks. According to Udry (1994), in the context of rural areas, borrowers who receive negative shocks are more likely to default. Moreover repayments can depend on random production and consumption shocks which affect borrowers and lenders. In these two cases, we consider that migrants who are, by definition not present in the community, are able to be considered as collateral in case of non repayment due precisely to these shocks. Therefore, the credit contract includes the borrower, the lender and the migrant. It seems to us that the role of trust of migrants is explained by the level of information asymmetry between the borrower and the lender. Indeed, if we consider that information asymmetries are low in rural areas and major part of loans are informal (Udry, 1994, 1990), lenders know that, whether a borrower has migrants in his household and it is very likely that they also know the characteristics of these migrants such as their gender, age or the destination location. Migrants play a "psychological" role on the level of trust of lenders. However, we want to go beyond the role of migrants as those who send money in case of tension on the incomes of the household's members. Even if they do not transfer at all or do not transfer on a regular basis,

we assume that migrants' presence in the household is a sort of signal of the reliability of borrowers because they constitute a potential solution in case of non repayment.

Second, risk sharing in the same community is made complicated when households have to face covariate shocks. According to Conning and Udry, 2007), this increases the willingness to make arrangements outside the community and in these cases, rural credit markets are able to be fragmented and imperfect due to the high diversity of borrowers. Therefore, lenders that do not necessarily belong to the close network of borrowers, have to deal with high information asymmetries. Indeed, they cannot check the reliability of the borrowers which increases costs of the loans. On the one hand, migrants through their remittances can make borrowers more reliable allowing them an easier access to credit. We also expect that migrants play an insurance role with lenders and increase the likelihood of having a loan and the loan size. In a word, even with high information asymmetry, migrants would positively influence the likelihood of getting a loan and the loan size.

However on the other hand, credit suppliers and migrants can both play an insurance role and by this way can be considered as substitutes. If the substitutability exists, we would expect a negative relationship between credit and migration variables. Shocks make access to the credit market more difficult by increasing the interest rate or by weakening solidarity mechanisms in the community where all households are affected by the same shocks (Yang and Choi, 2007). Fafchamps and Lund (2003), show that gifts and informal loans are highly correlated with negative shocks and small networks and relatives represent the primary source of help for rural household which have to deal with shocks. For instance, Rozensweig (1988) compares the role of credit and inter-household income

transfers in smoothing consumption ex post and he shows that inter-household transfers can substitute for credit arrangements and show that family transfers, over space and over time, are preferred to credit arrangements above all if credit supply is limited due to an under-performing local economy.

The purpose of the empirical part is then to test these assumptions and look at the sense of the relationship between credit and migration variables.

4.3. Data and Descriptive statistics

4.3.1. Data

Data are provided by a household survey conducted in eight regions of Senegal.[2] The survey was part of the program evaluation of multifunctional platform which is an initiative of the UNDP that allos electrification if rural areas.[3] The survey includes two waves: the baseline survey was made between May and July 2009 and we use data from this first wave to realize a cross-section study. The survey was made in villages with and without platforms[4]. The sample consists of 161 villages. Villages were randomly selected according to the criterion of not having access to energy. Villages non treated by the program and which are the counterfactual villages were selected on their likelihood of receiving the multifunctional program by 2011 by using matching method: each village treated and selected to be included in the sample is associated with villages not treated by

[2]The regions are Kaolack, Fatick, Diourbel, Tambacounda, Kedougou, Kolda, Thies and Louga.

[3]The survey was jointly conducted by CERDI (Clermont-Ferrand, France), Graduate Institute (Geneva, Switzerland) and Université Gaston Berger (Saint-Louis, Senegal).

[4]The sample groups together villages which received the program in 2009 i.e. villages with MP in 2009; villages which did not receive the program in 2009 but which will received it in 2011 and villages which did not receive the program neither in 2009, nor in 2011.

the program on the basis of similar characteristics. Within the villages, households were also selected randomly from the list of resident households in the village supplied by the head of the village[5]. The sample is representative for rural Senegal in which subsistence agriculture is the main sector that allows generating income.

4.3.2. Descriptive Statistics

Households are the unit of observation. For variables used in this study, information about all the household members is provided by one respondent. This respondent may be the head of the household or his spouse. The credit section of the questionnaire refers to all the household members who are more than 15 years old at the moment of the survey. This section tells us if there are any members of the household currently with a loan. If this is the case and if the respondent has the information, he gives the identification of the individual who gets the loan, the loan size, the origin and the reasons of loans. Migration data are supplied in the same way: the respondent reports if there are any migrants in the household or not. If yes and if it is possible, he gives information about each migrant in the household, such as his gender, his age, his destination location, the frequency of remittances and how much he remits to the household each time.

[Table 4.1 HERE]

[Table 4.2 HERE]

Table 4.1 reports the summary statistics. On 1769 households, 686 have at least one migrant in their household whereas 1083 households have none. 85% of migrants are

[5]The list of household supplied by the village head is based on payments of rural tax. The number of households present in the list were divided by 12 and a number between one and the number obtained was chosen, until getting twelve households.

male and their average age is 27 years old. Internal migrants which means migrants in Senegal represent 61% of total migrants; migrants to the Northern countries such as the U.S., France, Spain, Italy and other countries represent 30% whereas migrants to African countries are only 6%. This high rate of international migrants to Northern countries can be explained by the fact that the survey was also conducted in regions such as Louga where there is a lot of migration toward these countries. 73% of migrants have an occupation. In the case of the credit variables, 41 % of households have at least individual with a loan, 44% of households with a migrant have a loan versus 38% of households without a migrant. In our case, formal loans represent 34% and include loans from commercial banks, mutualist banks, microfinance institutions and village funds. Informal loans represent 66% of loans and are composed of loans from the employer, the family members, outside the family, "tontines", community stores and the category "other". Formal loans are smaller than informal loans, as find in the literature (Fafchamps and Lund, 2003; Udry, 1994), but they are not as low as one may expect. This may be due to the increasing presence of banking services such as microcredit. Table 4.2 shows the descriptive statistics of the credit variables. The average loan size is estimated at 124 910 Fcfa i.e. 190.25 Euro. The average formal loan size is equal to 48 140 Fcfa i.e. 73.32 Euro and the average informal loan size is equal to 76 760 Fcfa i.e. 116.91 Euro. The informal loan size is higher than the formal loan probably because there are more different origins for informal loan size than for formal loan size which is more expensive due to the interest rate. 58% of loans are taken for food consumption reasons, which represent more than the half of loans, whereas 27% of loans are used for beginning an activity or for

buying equipment for professional reasons. In the next section, we present the empirical strategy used to test the relation between migration and credit markets.

4.4. Empirical strategy

The aim of the empirical part is to study the effect of having a migrant in a household on the likelihood of an individual getting a loan and on the size of loan received. We use OLS and Tobit models as estimation methods. In addition to these methods, we also use the instrumental variable approach.

4.4.1. Identification strategy

In this part, we are interested in the impact of migrants on credit markets. The first objective is to estimate the impact of migrants on the likelihood of an individual getting a loan. The empirical approach is based on a OLS model. The specification is given by:

$$C_{ij} = \alpha migrant_i + \beta X_{ij} + \gamma Z_j + \epsilon_{ij} \tag{4.1}$$

Where: C_{ij} is a dummy variable equal to 1 if the household i in the village j gets a loan and 0 otherwise. $migrant_i$ is the variable of interest. It is a dummy equal to 1 if the household i in the village j gets a migrant in his household and 0 otherwise. α is the parameter to estimate. X_{ij} is a vector of control variables which include the household head and the household characteristics that can influence both migration and the likelihood of getting a loan. The household head characteristics are the gender, the

age, a dummy equal to 1 if the household head is literate. We do not have detailed information about the education level of adults. Therefore we use as proxy the variable literacy. It measures if he has at least an entry-level of education. We also control for his marital status by making the difference between single, monogamous and polygamous status of the household head. We assume that being polygamous, can affect migration and the credit variables. This is because polygamous households have more members, thus migration is less costly for them because it allows stream diversification of income (Gubert et al., 2010). We add another factor of explanation which is that there is often some competition and jealousy between different spouses and children who do not have the same mother. In Senegal, a migrant is often seen as someone who has succeeded. If there is not yet a migrant in the household, or even if there is one migrant in the household, this can involve the willingness of spouses to encourage the other sons to migrate. Being polygamous can also influence the likelihood of getting a loan and the loan size due to the supplementary expenses that this situation involves. The household characteristics include the ethnic dummies. We consider that belonging to Wolof, Pular, Soninke and Mandingue ethnic groups can both influence migration behavior and credit. Wolof is the biggest ethnic group in Senegal. Many people coming from the Pular ethnic group often have livestock holdings which are an indicator of wealth. Soninke people have a long tradition of migration and big migrant networks in France, Europe and the USA (Azam and Gubert, 2005). Soninke and Mandingue are also present in most West African countries and are often traders. We control for the number of people in the household depending on their gender and their age and for the number of literate people in the household. Since we do not have information about the income and expenditure

of the household, we use the durable assets, the livestock and the areas of Farmland to assess the wealth of households. The value of durable assets is estimated through the value of goods such as furniture, cars or televisions for each household. The variable "livestock" measures for each household, the value of livestock composed of animals such as cows, sheeps or horses in the household.[6] Farmland measures the total areas in hectares cultivated by the household. We control for a dummy equal to one if there are negative covariate and idiosyncratic shocks which can highly influence both migration and credit. Indeed, a household can decide to respond to these shocks by deciding to let of one their member migrate or thanks to loans. β is the parameter to estimate.

Z_j stands for the variable Platform, which is a village characteristic. Platform is a dummy taking into account if the household is in a village receiving the multifunctional platform program. ϵ_{ij} is the disturbance term.

Finally, we use clusters to control for village heterogeneity. Unobserved heterogeneity at the village level can be due to infrastructural differences and social environments which can influence the availability of information in villages (Udry, 1994) or performance of the village economy that can affect the credit markets (Rosenzweig, 1988).

[6]The common method used to estimate the value of assets and wealth is to use the principal component analysis. However, since we are interested in credit markets, it seems to us that is more relevant to use the asset liquidation value. Indeed, it is this value which will be considered by lenders or used as guarantee by borrowers and the principal component analysis does not tell us anything about the real value of these assets. Therefore, to obtain the liquidation value, we called some people living in rural areas in Senegal, more precisely in the region of Louga, one of the surveyed regions, and we asked them to take some information in the village market on the prices of different elements present in the variable "livestock" and on the new and second-hand prices of durable assets. We chose to use the second-hand prices of goods since these take wear and tear into account and we consider that, in case of non repayment, lenders could impound them and resell them at these prices. We multiply the number of durable assets by the average second-hand prices of these goods. We do the same thing for the livestock by using the prices on the market.

The second approach consists of studying the effect of having a migrant on the loan size. In this part, we consider that the loan size is equal to zero for people that do not get a loan and is higher than 0 for those with loans. Since we have a large proportion of zero, we use a Tobit model to estimate the equation of the loan size (Greene, 2008). The specification of the Tobit model is given by:

$$y_{ij}^{*} = \alpha migrant_i + \beta X_{ij} + \gamma Z_j + \epsilon_i \tag{4.2}$$

$$y_{ij} = 0 \; if \; y_{ij}^{*} \leq 0$$
$$y_{ij} = y_{ij}^{*} \; if \; y_{ij}^{*} > 0$$
$$and \; \epsilon_i \sim N(0, \sigma^2)$$

y_{ij} is the probability of having a loan or not and y_{ij}^{*} stands for the loan size. y_{ij}^{*} depends on the variable migrant and other factors of influence presented above.

4.4.2. Endogeneity issue and instrumental variable

We suspect the endogeneity of the variable migrant due to the potential reverse causation between credit variables and the fact of having a migrant in a household. If having a migrant in a household can explain loan access, credit can finance the migration of one or many household members. Thus, to avoid a potential reverse causation, we use as instrumental variable for migrant a dummy equal to one if there is a mobile phone in the household. In a recent literature, it is shown that mobile phones improve access to information which has a positive effect on economic development in Africa through, for

instance, the reduction of communication costs related to travel in agriculture markets (Aker, 2010). They also contribute to increase market efficiency or job creation (Aker and Mbiti, 2010). Furthermore, mobile phones are a "democratic" mean of communication more accessible to the less educated or to people in rural areas. Sub-Saharan Africa (SSA) has made much progress in the mobile phones field. For instance, 60% of the Sub-Saharan African population can get a signal and African villages are quite well covered (Aker and Mbiti, 2010). According to the International Telecommunications Union (ITU)[7], 40% of rural areas were covered by a signal in SSA in 2006 and mobile phones have made a good penetration in African markets. There are few economic studies on the impact of mobile phones on social networks. However, some research shows that mobile phones facilitate communication among social network within the country and abroad in the case of shocks. Bloomenstock et al. (2011), for instance, from the example of a natural disaster such as an earthquake in Rwanda, show how mobile phones via airtime transfers can help to share risk over the distance and deal with covariate shocks. Aker et al. (2011) suggest that mobile phones have an effect on rural households and more specifically on internal migration in Niger. They find that access to and learning how to use a mobile phone, affect the probability of migration by increasing information on job market opportunities. Mobile phones allow students to communicate more with migrants in Niger and then affect labor mobility. We argue that the variable mobile phone is exogenous and not correlated to the error term. The reasons of this assupmtion are various. In Senegal, about 70% of the population have access to mobile phones and the number of lines is high as a proportion of the population (Chéneau-Loquay, 2001). There is a good communications

[7] www.intu.int

network and competition on the telecommunications market with some new operators, allow a larger coverage of the national territory and a great reduction in prices. In a word, since mobile phones are widely present in Senegal, even in rural areas, their costs have greatly decreased, they are easily lost or stolen, thus we assume that they cannot be used to guarantee a loan.

4.5. Results

4.5.1. The effect of migrants on the likelihood of getting a loan

[Table 4.3 HERE]

[Table 4.4 HERE]

Estimates of equation (4.1) are presented in Table 4.3. Columns 1 and 2 present results of the estimates with the variables migrant which is statistically significant at 5% and positive. Columns 3 and 4 present results of the estimates with migrant characteristics such as gender, age, destination of the migrant, a dummy equal to one if the migrant has an occupation. In order to control for the selection issue for households which do not have migrants, we also add the hazard rate computed from the probit explaining the likelihood of having a migrant (see Appendix). Only the variable gender of migrant is significant at 1% and negative. It means that having a male as migrant decreases the likelihood of getting a loan instead of having a migrant who is female. This result suggests that female migrants may be more reliable to the borrowers than male migrants. Table 4.4 presents the effect of migrants on the likelihood of getting a loan using the instrumental variable approach and more specifically the two-stage least squares. It also presents the relationship between having a migrant and the likelihood of getting a loan for professional

reasons or for food consumption. The instrument mobile phone is statistically significant at 1% level and positive. This result supports the findings in the literature that, by enabling a migrant network to remain in contact, a mobile phone increases the likelihood of migration. The F-statistic of this variable is equal to 10.48 with a p-value of 0.002 which supports the validity of the instrument. After controlling for potential reverse causality, the result of the variable migrant (Columns 1 and 2) is significant at 1% level and positive. It means that having a migrant in a household increases the likelihood of having a loan in a household which is consistent with our assumptions that a migrant constitutes a collateral in the credit contract between borrower and lender and his existence in the household can increase the trust level of the lender and then the likelihood of getting a loan. The effect of the variable migrant remains significant and positive whether the loan is taken to start an activity, to buy some materials for professionnal reasons (Columns 3 and 4) or for food consumption needs (Columns 5 and 6), even though for the latter the result is significant only at a level of 10%.

4.5.2. The effect of migrants on the loan size

[Table 4.5 HERE]

The impact of migrants on the loan size (equation 4.2) is presented in Columns 1 and 2 of Table 4.5 which show the results of Tobit estimates. Before controlling for the potential reverse causality, the variable migrant is not significant. However, after controlling for the potential reverse causality, result of the IVtobit estimates becomes significant and positive (Columns 3 and 4). Having a male as household head increases the loan size, whereas the age of the household head is negatively associated with the likelihood of having a loan.

Having an older household head often means higher earnings and therefore a lower need to borrow in the household. Whether the household head is monogamous or polygamous does not have any effect on the loan size relatively to a single household head. The Pular and Soninke dummies are significant at a level of 5% and negative, whereas Mandingue dummy is significant at 10% and has also a negative sign. Due to the high proportion of migrants often present in these ethnic groups, above all for Soninke and Mandingue, we would expect a positive sign, all the more so the variable migrant is positive. We have two explanations for this result. One may assume that these groups, with their large migrant networks (Azam and Gubert, 2005), have many recourses and are able to be helped by different relatives belonging to their migrant networks instead of asking for a loan, which reduces their willingness to borrow. In this case, it seems that migrants' network are preferred to credit contracts. The other possible explanation is to associate the negative sign of these ethnic dummies to a wealth effect probably due to the fact that in these ethnic groups people often have a professional activity which could make them richer. Richer individuals can more easily finance themselves and are less likely to ask for a loan. Pular, for instance, constitutes a part of Fulani's and their assets such as livestock holdings, probably allow them to reduce the loan size. Moreover, two wealth indicators such as the variable livestock and farmlands are negatively related to the loan size though they are not significant.

Table 4.6 and 4.7 use IVtobit model and present the results of the effect of having a migrant in a household on the loan size by making the difference between the formal and the informal loan size respectively. The variable migrant remains significant and positive in both cases. It is significant at 10% for the formal loan size and at 5% for the informal

loan size. The partial effect presented in Column 3 in both tables measures the effect of the independent variable migrant on the loan size if there are loans in the household. This probability is both conditional on the independent variables and on the part of the dependent variable which is not censored (Wooldridge, 2001). Results show that having a migrant in a household largely increases the formal and the informal loan size. However the effect is stronger for the informal loan size (significant at level of 5%) than for the formal loan size (significant at level of 10%). Thus, having a migrant increases by 494 320 Fcfa i.e. 495 Euros the formal loan size for all people in a household with a migrant. This amount is estimated at 474 500 Fcfa i.e. 474 Euros for the informal loan size.

4.6. Concluding remarks

The aim of this chapter is to study the impact of migrants on the likelihood of getting a loan in a household and on the loan size. Suspecting potential reverse causality bias of the migration variable, we instrument it by using the presence of a mobile phone in the household. Our results show a positive relationship between migrant and credit variables. As a check for robustness, we are interested in the motives for obtaining a loan, and results show that for professional or food consumptions reasons, having a migrant in a household increases the likelihood of getting a loan. We also find that having a migrant significantly increases both the formal and the informal loan size received by borrowers. However, the effect is stronger for the informal than for the formal loan size. These results support our assumptions that migrants increase the reliability of their family's members and close relatives back home and insure them to lenders in case of credit contracts.

Therefore, in terms of implications, it would be interesting to envisage how migrants can be associated more officially to credit contracts. This may help to finance a more complete investment for the most vulnerable.

In order to extent the relationship between migration and credit variables, future research can also assess the effect of remittances on credit markets. In this case, since loans can take the form of remittances and vice versa, it would be interesting to find a way to disentangle remittances and loans.

Table 4.1. Summary statistics

	Migrant HH (N=686)		Non-migrant HH (N=1083)		Total (N=1769)	
Variables	Mean	S.D	Mean	S.D	Mean	S.D
Credit	0.44	0.50	0.38	0.49	0.41	0.49
Migrant's characteristics						
Male	0.85	0.36			0.85	0.36
Age	27.17	10.75			27.17	10.75
Internal migration	0.61	0.49			0.61	0.49
Destination Africa	0.06	0.24			0.06	0.24
Destination Northern countries	0.30	0.46			0.30	0.46
Occupation	0.73	0.44			0.73	0.44
HH characteristics						
HH Head is male	0.95	0.23	0.97	0.16	0.97	0.18
HH Head age	55.49	14.72	50.62	13.77	52.48	14.36
HH Head literate	0.51	0.50	0.46	0.50	0.49	0.50
HH Head single	0.15	0.36	0.19	0.40	0.18	0.38
HH Head monogamous	0.39	0.49	0.43	0.50	0.42	0.49
HH Head polygamous	0.46	0.50	0.37	0.48	0.40	0.49
Wolof	0.45	0.50	0.45	0.50	0.44	0.50
Pular	0.17	0.37	0.25	0.43	0.22	0.41
Soninke	0.08	0.26	0.03	0.18	0.05	0.22
Mandingue	0.06	0.23	0.05	0.21	0.05	0.22
Number of male>14	2.83	1.99	2.66	1.83	2.7	1.88
Number of female >14	3.27	2.04	2.81	1.78	2.97	1.91
Number of male<14	2.66	2.20	2.45	1.97	2.48	2.04
Number of female<14	2.50	2.09	2.23	1.75	2.3	1.88
Number of literate people	3.25	3.03	2.54	2.78	2.83	2.88
Farmland areas	5.84	8.21	4.97	6.10	5.25	6.9
Durable Assets	461.12	495.20	349.72	464.84	389.98	475.58
Livestock	1085.17	1812.22	952.80	1761.70	974.66	1729.10
Covariate shocks	0.89	0.31	0.90	0.30	0.89	0.31
Idiosyncratic shocks	0.08	0.28	0.04	0.21	0.06	0.24
Mobile phone	0.69	0.46	0.57	0.50	0.61	0.49
Number of mobile phones	1.20	1.51	0.89	1.21	0.98	1.31
Village characteristics						
Platform	0.36	0.48	0.30	0.46	0.32	0.47

Notes: Amounts are denominated in thousands of Fcfa. 1 Euro=656.56 FCFA.

Table 4.2. Summary statistics of credit variables

Variables	Mean	SD	N
Loan for professional activity	0.27	0.45	723
Loan for food consumption	0.58	0.49	723
Loan size	124.91	459.54	691
Formal loan size	48.14	208.09	691
Informal loan size	76.76	417.67	691

Notes: Amounts are denominated in thousands of Fcfa.

Table 4.3. Effect of migrants on the likelihood of getting a loan: OLS estimates

	OLS			
	Dependent variable: Loan			
	Coef.	t-stat	Coef.	t-stat
Independent variables	(1)	(2)	(3)	(4)
Migrant	0.071**	(2.36)		
Migrant characteristics				
Male			-0.205***	(3.09)
Age			0.001	(0.22)
Destination Africa			0.023	(0.21)
Destination Northern countries			-0.110	(1.33)
Occupation			-0.015	(0.21)
Hazard rate			-0.646**	(2.44)
HH characteristics				
HH Head is male	0.003	(0.03)	0.151	(0.86)
HH Head age	0.000	(0.24)	-0.006	(1.64)
HH Head literate	0.029	(0.84)	-0.037	(0.55)
HH Head monogamous	0.009	(0.19)	0.035	(0.32)
HH Head polygamous	0.004	(0.08)	0.052	(0.43)
Wolof	-0.108*	(1.97)	-0.109	(1.53)
Pular	-0.251***	(4.55)	-0.241**	(2.49)
Soninke	-0.269***	(3.06)	-0.283**	(2.30)
Mandingue	-0.180**	(2.28)	-0.109	(0.69)
Number of male>14	-0.005	(0.52)	0.012	(0.62)
Number of female >14	0.015	(1.29)	-0.005	(0.24)
Number of male<14	-0.009	(1.20)	0.003	(0.20)
Number of female<14	0.009	(0.96)	0.004	(0.25)
Number of literate people	0.018***	(2.64)	0.005	(0.42)
Farmland areas	-0.006**	(2.18)	-0.003	(0.61)
Durable Assets	0.000	(0.60)	-0.000	(0.78)
Livestock	-0.000	(0.66)	0.000	(0.10)
Covariate shocks	0.053	(0.74)	-0.402	(1.33)
Idiosyncratic shocks	0.232***	(2.62)	-0.406	(1.20)
Village characteristics				
Platform	0.021	(0.44)	-0.060	(0.89)
Observations	1110		359	
R^2	0.10		0.16	

Notes: Absolute robust t-statistics in parentheses. *significant at 10%, **significant at 5%, ***significant at 1%. The reference category for the destination of the migrant is internal migration. The reference category for the HH marital status is single. All estimations include a constant and cluster at the village level. Estimation with the migrants' characteristics is run with bootstrap procedure (1000 replications).

Table 4.4. Effect of migrants on the likelihood of getting a loan: IV approach

	2SLS					
	Loan		Loan for job		Loan for food	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Migrant	1.796***	(2.68)	0.797***	(2.63)	0.646*	(1.74)
HH characteristics						
HH Head is male	0.347*	(1.67)	0.114	(1.15)	0.211**	(2.06)
HH Head age	-0.009**	(2.10)	-0.004*	(1.81)	-0.003	(1.44)
HH Head literate	-0.096	(1.07)	-0.040	(0.90)	-0.063	(1.46)
HH Head monogamous	-0.080	(0.72)	0.002	(0.03)	-0.027	(0.46)
HH Head polygamous	-0.033	(0.31)	0.038	(0.78)	-0.016	(0.27)
Wolof	-0.037	(0.41)	0.033	(0.74)	-0.045	(0.96)
Pular	-0.230**	(2.47)	-0.061	(1.39)	-0.143***	(2.73)
Soninke	-0.395**	(2.56)	-0.106	(1.32)	-0.190***	(2.59)
Mandingue	-0.307**	(2.36)	-0.114*	(1.66)	-0.095	(1.31)
Number of male>14	0.036	(1.34)	0.021*	(1.72)	0.009	(0.60)
Number of female >14	-0.014	(0.52)	-0.016	(1.38)	-0.001	(0.05)
Number of male<14	-0.010	(0.71)	-0.007	(0.94)	-0.006	(0.76)
Number of female<14	-0.015	(0.76)	0.000	(0.03)	-0.005	(0.48)
Number of people literate	0.002	(0.11)	-0.008	(1.20)	0.006	(0.85)
Farmland areas	-0.006	(1.04)	-0.003	(0.99)	-0.000	(0.03)
Durable Assets	-0.000	(0.25)	0.000	(0.98)	-0.000	(0.81)
Livestock	-0.000	(0.57)	-0.000	(0.38)	-0.000	(1.04)
Covariate shocks	-0.266	(1.56)	-0.145*	(1.84)	-0.007	(0.07)
Idiosyncratic shocks	-0.359	(1.21)	-0.209	(1.49)	0.089	(0.54)
Village characteristics						
Platform	-0.063	(0.78)	-0.020	(0.53)	-0.038	(0.89)
Independent variables	First-stage					
Mobile phone	0.099***	(3.25)	0.099***	(3.25)	0.099***	(3.25)
Observations	1110		1110		1110	
R^2	0.08		0.08		0.08	
Wald test of exogeneity						
Chi2 (1)	18.29		15.24		03.43	
Prob>chi(2)	0.000		0.000		0.066	
Weak instrument test						
F-statistic	10.48		10.48		10.48	
Prob > F	0.002		0.002		0.002	

Notes: Absolute robust t-statistics in parentheses. *significant at 10%, **significant at 5%, ***significant at 1%. The reference category for the HH marital status is single. All estimations include a constant and cluster at the village level.

Table 4.5. Effect of migrants on loan size

	Loan size			
	Tobit		IVtobit	
	Coef.	z-stat	Coef.	z-stat
Independent variables	(1)	(2)	(3)	(4)
Migrant	27.419	(0.90)	1711.425**	(2.37)
HH characteristics				
HH Head is male	13.072	(0.17)	350.743*	(1.68)
HH Head age	-1.189	(0.74)	-10.585**	(2.14)
HH Head literate	20.428	(0.50)	-101.691	(1.09)
HH Head monogamous	39.815	(0.65)	-72.313	(0.62)
HH Head polygamous	27.339	(0.44)	-46.448	(0.40)
Wolof	-9.928	(0.20)	49.680	(0.54)
Pular	-225.022***	(3.06)	-212.719**	(1.96)
Soninke	-249.188**	(2.40)	-372.428**	(2.23)
Mandingue	-115.482	(1.44)	-247.021*	(1.88)
Number of male>14	8.392	(0.50)	45.783	(1.41)
Number of female >14	1.943	(0.12)	-28.364	(0.89)
Number of male<14	-13.589	(1.62)	-13.967	(0.96)
Number of female<14	-0.106	(0.01)	-21.860	(1.04)
Number of literate people	26.175	(1.52)	14.513	(0.75)
Farmland areas	-3.672	(0.86)	-4.219	(0.68)
Durable Assets	0.204	(1.48)	0.165	(1.07)
Livestock	-0.006	(0.49)	-0.011	(0.44)
Covariate shocks	114.272	(0.97)	-220.014	(1.14)
Idiosyncratic shocks	337.365	(1.59)	-271.251	(0.82)
Village characteristics				
Platform	-11.104	(0.22)	-103.545	(1.12)
Independent variables			First-stage	
Mobile phone			0.101***	(3.33)
Observations	1083		1083	
Uncensored observations			428	
Wald test of exogeneity				
Chi2 (1)			5.42	
Prob>chi(2)			0.02	

Notes: Absolute z-statistics in parentheses. *significant at 10%, **significant at 5%, ***significant at 1%. The reference category for the HH marital status is single. All estimations include a constant and cluster at the village level.

Table 4.6. Effect of migrants on formal loan size: IVtobit

	Formal loan size		
	Coef.	z-stat	Partial effect>0
Independent variables	(1)	(2)	(3)
Migrant	1725.229*	(1.82)	494.320
HH characteristics			
HH Head is male	180.570	(0.69)	41.244
HH Head age	-9.216	(1.56)	-2.217
HH Head literate	55.512	(0.54)	13.359
HH Head monogamous	128.481	(0.88)	31.008
HH Head polygamous	128.491	(1.00)	31.101
Wolof	83.435	(0.80)	20.166
Pular	-347.071**	(2.23)	-78.140
Soninke	-380.593*	(1.78)	-82.532
Mandingue	-321.924	(1.58)	-70.836
Number of male>14	45.077	(1.54)	10.842
Number of female >14	-10.064	(0.34)	-2.421
Number of male<14	-28.044	(1.53)	-6.745
Number of female<14	-3.104	(0.14)	-0.747
Number of literate people	-28.550	(1.64)	-6.867
Farmland areas	-4.403	(0.60)	-1.059
Durable Assets	0.048	(0.48)	0.012
Livestock	0.012	(0.44)	0.003
Covariate shocks	-305.269	(1.25)	-79.501
Idiosyncratic shocks	-533.163	(1.34)	-111.707
Village characteristics			
Platform	-25.357	(0.25)	-6.082
Independent variables	First-stage		
Mobile phone	0.101***		
Observations	1083		
Uncensored observations	145		
Wald test of exogeneity			
Chi2 (1)	3.29		
Prob>chi(2)	0.07		

Notes: Absolute z-statistics in parentheses. *significant at 10%, **significant at 5%, ***significant at 1%. The reference category for the HH marital status is single. All estimations include a constant and cluster at the village level.

Table 4.7. Effect of migrants on informal loan size: IVtobit

	Informal loan size		
	Coef.	z-stat	Partial effect>0
Independent variables	(1)	(2)	(3)
Migrant	1509.638**	(2.07)	474.500
HH characteristics			
HH Head is male	383.850*	(1.88)	90.803
HH Head age	-9.357*	(1.78)	-2.494
HH Head literate	-175.020	(1.59)	-46.599
HH Head monogamous	-197.462	(1.56)	-52.403
HH Head polygamous	-146.567	(1.20)	-38.791
Wolof	-25.452	(0.31)	-6.774
Pular	-149.573	(1.50)	-38.610
Soninke	-303.590*	(1.87)	-73.816
Mandingue	-205.036	(1.58)	-51.304
Number of male>14	40.468	(1.18)	10.788
Number of female >14	-31.093	(0.96)	-8.289
Number of male<14	-6.192	(0.46)	-1.651
Number of female<14	-21.906	(1.06)	-5.840
Number of literate people	31.873	(1.35)	8.496
Farmland areas	-3.637	(0.70)	-0.969
Durable Assets	0.143	(0.92)	0.038
Livestock	-0.018	(0.87)	-0.005
Covariate shocks	-131.391	(0.68)	-36.359
Idiosyncratic shocks	-92.948	(0.29)	-24.102
Village characteristics			
Platform	-138.404	(1.38)	-36.290
Independent variables			
Mobile phone	0.101***	(3.33)	
Observations	1083		
Uncensored observations	313		
Wald test of exogeneity			
Chi2 (1)	4.02		
Prob>chi(2)	0.04		

Notes: Absolute z-statistics in parentheses. *significant at 10%, **significant at 5%, ***significant at 1%. The reference category for the HH marital status is single. All estimations include a constant and cluster at the village level.

Appendix

A. Probit estimate of the likelihood of having a loan in a household

	Coef.	z-stat
Independent variables	(1)	(2)
HH characteristics		
HH Head is male	-0.601***	(2.91)
HH Head age	0.015***	(5.33)
HH Head literate	0.150	(1.59)
HH Head monogamous	0.138	(0.93)
HH Head polygamous	0.094	(0.64)
Wolof	-0.146	(1.29)
Pular	-0.028	(0.22)
Soninke	0.289	(1.42)
Mandingue	0.247	(1.38)
Number of male>14	-0.070**	(2.30)
Number of female >14	0.047*	(1.69)
Number of male<14	0.005	(0.26)
Number of female<14	0.018	(0.84)
Number of literate people	0.024	(1.43)
Farmland areas	0.002	(0.23)
Durable Assets	0.000	(0.45)
Livestock	0.000	(0.92)
Covariate shocks	0.629**	(2.43)
Idiosyncratic shocks	1.080***	(3.44)
Mobile phone	0.328***	(3.81)
Village characteristics		
Platform	0.110	(1.16)
Observations	1182	
Pseudo-R^2	0.07	

Notes: Absolute robust z-statistics in parentheses. *significant at 10%, **significant at 5%, ***significant at 1%. All regressions include a constant and cluster at the village level.

References

[1] Adams Jr., R. H. and Cuecuecha, A. (2010): "Remittances, Household Expenditure and Investment in Guatemala", *World Development,* 38(11), 1626-1641.

[2] Aggarwal, R.; Demirgüç-Kunt, A. and Pería, M. S. M. (2011): "Do remittances promote financial development?", *Journal of Development Economics* 96(2), 255-264.

[3] Aker, J. C. (2010): "Information from Markets Near and Far: Mobile Phones and Agricultural Markets in Niger", *American Economic Journal: Applied Economics,* 2(3), 46-59.

[4] Aker, J. C.; Clemens, M. A. and Ksoll, C. (2011): "Mobiles and mobility: The Effect of Mobile Phones on Migration in Niger"(2), Technical report, Verein für Socialpolitik, Research Committee Development Economics.

[5] Aker, J. C. and Mbiti, I. M. (2010): "Mobile Phones and Economic Development in Africa", *Journal of Economic Perspectives,* 24(3), 207-32.

[6] Amuedo-Dorantes, C. and Pozo, S. (2011): "Remittances and Income Smoothing", *American Economic Review,* 101(3), 582-87.

[7] Azam, J.-P. and Gubert, F. (2005): "Those in Kayes. The Impact of Remittances on Their Recipients in Africa", *Revue économique,* 56(6), 1331-1358.

[8] Blumenstock, J.; Eagle, N. and Fafchamps, M. (2011): "Risk and Reciprocity Over the Mobile Phone Network: Evidence from Rwanda", Technical report, Centre for the Study of African Economies, University of Oxford.

[9] Brown, R., P., C.; Carmignani, F. and Fayad, G. (2011): "Migrants' Remittances and financial Development: Macro- and Micro-level Evidence of a Perverse Relationship", Technical report, Oxford Centre for the Analysis of Resource Rich Economies, University of Oxford.

[10] Chéneau-Locquay, A. (2001): "Les territoires de la téléphonie mobile en Afrique", NETCOM, 15 (1-2).

[11] Combes, J.-L. and Ebeke, C. (2011): "Remittances and Household Consumption Instability in Developing Countries", *World Development*, 39(7), 1076-1089.

[12] Conning, J. and Udry. (2007): "Rural Financial Markets in Developing Countries", In Handbook of Agricultural Economics, C.Evenson, R. and Pingali, P., eds., Elsevier, Chapter 56, 2857-2908.

[13] Demirgüç-Kunt, A.; Córdova, E. L.; Pería, M. S. M. and Woodruff, C. (2011): "Remittances and banking sector breadth and depth: Evidence from Mexico", *Journal of Development Economics,* 95(2), 229-241.

[14] Fafchamps, M. and Lund, S. (2003): "Risk-sharing networks in rural Philippines", *Journal of Development Economics,* 71(2), 261-287.

[15] Greene, W., H., (2008): "Econometric Analysis" (5th Edition), Prentice Hall.

[16] Gubert, F. (2002): "Do Migrants Insure Those who Stay Behind? Evidence from the Kayes Area (Western Mali)", *Oxford Development Studies,* 30(3), 267-287.

[17] Gubert, F.; Lassourd, T. and Mesplé-Somps, S. (2010): "Transferts de fonds des migrants, pauvreté et inégalités au Mali. Analyse à partir de trois scénarios contrefactuels", *Revue économique*, 61(6), 1023-1050.

[18] Gupta, S.; Pattillo, C. A. and Wagh, S. (2009): "Effect of Remittances on Poverty and Financial Development in Sub-Saharan Africa", *World Development,* 37(1), 104-115.

[19] Mesnard, A. (2004): "Temporary migration and capital market imperfections", *Oxford Economic Papers*, 56(2), 242-262.

[20] Richter, S. M. (2008): "The Insurance Role of Remittances on Household Credit Demand", Technical report, American Agricultural Economics Association (New Name 2008: Agricultural and Applied Economics Association).

[21] Rosenzweig, M. R. (1988): "Risk, Implicit Contracts and the Family in Rural Areas of Low-income Countries", *Economic Journal*, 98(393), 1148-70.

[22] Udry, C. (1994): "Risk and Insurance in a Rural Credit Market: An Empirical Investigation in Northern Nigeria", *Review of Economic Studies,* 61(3), 495-526.

[23] Udry, C. (1990): "Credit Markets in Northern Nigeria: Credit as Insurance in a Rural Economy", *World Bank Economic Review,* 4(3), 251-69.

[24] Woodruff, C. and Zenteno, R. (2007): "Migration networks and microenterprises in Mexico", *Journal of Development Economics*, 82(2), 509-528.

[25] Wooldridge, J. M. (2001): "Econometric Analysis of Cross Section and Panel Data", Vol. 1, The MIT Press.

[26] Yang, D. (2008): "Coping with Disaster: The Impact of Hurricanes on International Financial Flows, 1970-2002", *The B.E. Journal of Economic Analysis & Policy",* 8(1), 13.

[27] Yang, D. and Choi, H. (2007): "Are Remittances Insurance? Evidence from Rainfall Shocks in the Philippines", *World Bank Economic Review,* 21(2), 219-248.

General Conclusion

The main purpose of this thesis was to have a better understanding of the relationship between migration and three major challenges faced by developing countries namely the environmental issue, the phenomenon of illegal migration and the development of credit markets. We then ask four main questions: how can natural disasters, mainly due to climate change, affect migration in developing countries? How are the intentions of people formed regarding the decision to migrate illegally in urban Senegal? How do individual preferences affect the willingness to migrate illegally and to pay a smuggler? How can migrants influence credit markets in the context of rural Senegal?

In the first chapter, we found that natural disasters increase the rate of emigration but we also found some heterogeneity in this effect depending on the type of disaster. Climatological disasters have only a lagged effect on migration whereas the other types of disaster have a contemporaneous and lagged positive impact on migration. There is also some heterogeneity of the effect of natural disasters on migration according to people's level of education. Our results show that natural disasters have an effect only on the migration of people with a high level of education. Furthermore, we found some differences in migration behavior between highly educated people depending on their geographical location. Natural disasters mainly due to climate change raise equity issues for developing countries because they induce the migration of qualified and skilled people when these countries are at their most vulnerable. Greater efforts could be made by both developing and developed countries in order to reduce environmental degradation above all in the poorest countries which contribute the least towards this environmental decline but which suffer the greatest consequences.

In the second chapter, our results show that potential illegal migrants are willing to accept a substantial risk of death. They tend to be young, single and with a low level of education. We also found a negative relationship between the price of illegal migration and the willingness to migrate illegally which suggests that the poorest Senegalese people will not be able to attempt illegal migration. People may base their illegal migration project on wrong information because we found that biased expectations towards the popular destination countries increase the likelihood to migrate illegally. Moreover, our results show that having relatives who have already migrated increase the illegal migration intention. Migrant networks give an idea of their life abroad that can be accurate, or not so accurate, and which can increase the desire of potential illegal migrants to leave Senegal. A tightening of immigration policies for entering host countries deter more legal than illegal potential migrants which can be interpreted as a pernicious effect. Finally, our study shows that some destinations such as Spain or Italy are more attractive and more correlated with the intention to migrate illegally from Senegal than is France, the U.S. or the United Kingdom. These results imply that in order to reduce illegal migrant flows, immigration policies have to be more focused on the formation of intentions, which are the first step of an illegal migration project.

The third chapter completes the second one by studying the role of time and risk preferences in the intention to migrate illegally and in the willingness to pay a smuggler with a probability one of success. From a theoretical model, our comparative statistics show that the likelihood of migrating illegally is an increasing function of the intertemporal discount rate, an ambiguous function of risk aversion, an increasing function of the expected foreign wage and a decreasing function of the price of illegal migration. Second, the

willingness to pay a smuggler for an illegal immigration attempt with probability one of success is an increasing function of the intertemporal discount rate, a decreasing function of risk-aversion, an increasing function of the expected foreign wage, and an ambiguous function of the domestic wage. We tested our theoretical predictions empirically, except the effect of the intertemporal discount rate and risk aversion on the illegal migration intention due to the non-availability of the data for potential legal migrants. All other theoretical predictions are confirmed by the empirical estimations. We also show in the empirical part that the willingness to pay a smuggler is positively related to the lump sum payment necessary to induce an individual not to leave Senegal. This result suggests that potential illegal migrants assign a high monetary value to illegal migration and have a high utility gap between migrating and remaining in Senegal. Individual preferences matter and then have to be considered and taken into account in the explanation of illegal migration.

The last chapter shows that migrants increase the likelihood of getting a loan and the loan size. We also find that this positive relationship between migrants and the credit variables remains significant whether the loan is taken for professional or food consumption reasons or whether the loan size received by borrowers comes from formal institutions or informal channels. However, the effect is stronger for the informal than for the formal loan size. These results support the idea that migrants make life more stable for their relatives left behind and insure them to lenders in case of credit contracts. It would be then interesting to consider the implication of migrants in credit contracts.